ForeRunner® ES-3810 Installation and Maintenance Manual

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Software Version 4.13.x and 5.1.x

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FCC CLASS A NOTICE

WARNING: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void this user's authority to operate this equipment.

NOTE: The ASX-200WG, the ASX-200BX, the ASX-1000, and the *ForeRunnerLE*™ 155 have been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of the equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

DOC CLASS A NOTICE

This digital apparatus does not exceed Class A limits for radio noise emission for a digital device as set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le present appareil numerique n’emet pas de bruits radioelectriques depassant les limites applicables aux appareils numeriques de la class A prescrites dans le reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.

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受信機等に受信障害を与えることがあります。

取扱説明書に従って正しい取り扱いをして下さい。

This equipment is in the Class 1 category (Information Technology Equipment to be used in commercial and/or industrial areas) and conforms to the standards set by the Voluntary Control Council For Interference by Information Technology Equipment aimed at preventing radio interference in commercial and/or industrial areas.Consequently, when used in a residential area or in an adjacent area thereto, radio interference may be caused to radios and TV receivers, etc. Read the instructions for correct handling.

FCC REQUIREMENTS (Notice to Users of DS1 Service)

The following instructions are provided to ensure compliance with the FCC Rules, Part 68.

(1) This device must only be connected to the DS1 network connected behind an FCC Part 68 registered channel service unit. Direct connection is not allowed.

(2) Before connecting your unit, you must inform the telephone company of the following information:

Port ID	REN/SOC	FIC	USOC
NM-6/DS1C	6.0N	04DU9-BN, 04DU9-DN,	RJ48C
NM-2/DS1C	6.0N	04DU9-1ZN, and 04DU9-1SN	RJ48C

(3) If the unit appears to be malfunctioning, it should be disconnected from the telephone lines until you learn if your equipment or the telephone line is the source of the trouble. If your equipment needs repair, it should not be reconnected until it is repaired.

(4) If the telephone company finds that this equipment is exceeding tolerable parameters, the telephone company can temporarily disconnect service, although they will attempt to give you advance notice if possible.

(5) Under the FCC Rules, no customer is authorized to repair this equipment. This restriction applies regardless of whether the equipment is in or out of warranty.

(6) If the telephone company alters their equipment in a manner that will affect use of this device, they must give you advance warning so as to give you the opportunity for uninterrupted service. You will be advised of your right to file a complaint with the FCC.

CANADIAN IC CS-03 COMPLIANCE STATEMENT

NOTICE: The Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Industry Canada label does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

E1 AND E3 NOTICE

The E1 (NM-6/E1C and NM-2/E1C) and E3 (NM-4/E3C and NM-2/E3C) network modules that are described in this manual are approved for use in FORE Systems' host systems providing that the instructions below are strictly observed. Failure to follow these instructions invalidates the approval.

Pan European Approval - CE Marking

Pan European approval of the E1 network module was issued by BABT following assessment against CTR12. This means that it can be connected to ONP and unstructured PTO-provided private circuits with 120 Ω interfaces in all European countries, according to Telecommunications Terminal Equipment (TTE) Directive 91/263/EEC. Thus, the following CE mark applies:

CE168X

The E1 and E3 network modules conform to safety standard EN60950 1992 following the provisions of Low Voltage Product Safety Directive 73/23/EEC and CE Marking Directive 93/68/EEC, and can be marked accordingly with the CE symbol.

The E1 and E3 network modules conform to EN55022 1994 and EN50082-1 1992 following the provisions of the EMC Directive 89/336/EEC, and can be marked accordingly with the CE symbol.

National Approvals

UK

Network Module	Connects to	Approval Number
E1	Structured and unstructured PTO-provided private circuits with 75 Ω interfaces	AA60953
E3	PTO-provided private circuits with 75 Ω interfaces	NS / 4387 / 1 / T / 605954

Germany

Network Module	Connects to	Approval Number
E3	Structured PTO-provided private circuits with 75 Ω interfaces	A127535H for the ASX-1000 A127534H for the ASX-200BX or ASX-200WG

Switzerland

Network Module	Connects to	Approval Number
E1	Structured PTO-provided private circuits with 120 Ω interfaces	96.0872.J.N
E3	Structured PTO-provided private circuits with 75 Ω interfaces	96.0873.J.N

Required User Guide Statements - UK Installation

The use of auxiliary products not authorized by FORE Systems® in FORE Systems ATM Switches may cause the power specification to be exceeded and is a potential safety hazard.

The equipment must be installed such that with the exception of the connections to the host, clearance and creepage distances shown in the table below are maintained between the network module and any other assemblies which use or generate a voltage shown in the table below. The larger distance shown in brackets applies where the local environment within the host is subject to conductive pollution or dry non-conductive pollution which could become conductive due to condensation. Failure to maintain these minimum distances invalidates the approval.

Clearance (mm)	Creepage (mm)	Voltage Used or Generated by Host or by Network Modules
2.0	2.4 (3.8)	Up to 50 V_{rms} or V_{dc}
2.6	3.0 (4.8)	Up to 125 V_{rms} or V_{dc}
4.0	5.0 (8.0)	Up to 250 V_{rms} or V_{dc}
4.6	6.4 (10.0)	Up to 300 V_{rms} or V_{dc}

For a host or other expansion card fitted in the host, using or generating voltages greater than 300V (rms or dc), advice from a competent telecommunications engineer must be obtained before installation of the relevant equipment.	Above 300 V_{rms} or V_{dc}

NOTE: Installing the network modules in the appropriate FORE Systems hosts, according to the installation instructions provided, satisfies the requirements listed above.

The following tables show the available ports and their safety status:

NM-6/E1C and NM-2/E1C

Ports	Safety Status
E1 Ports	TNV operating at SELV
Bus Connector	SELV

NM-4/E3C and NM-2/E3C

Ports	Safety Status
E3 Ports	TNV operating at SELV
Bus Connector	SELV

CE NOTICE

Marking by the symbol **CE** indicates compliance of this system to the EMC (Electromagnetic Compatibility) directive of the European Community and compliance to the Low Voltage (Safety) Directive. Such marking is indicative that this system meets or exceeds the following technical standards:

- EN 55022 - "Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment."
- EN 50082-1 - "Electromagnetic compatibility - Generic immunity standard Part 1: Residential, commercial, and light industry."
- IEC 1000-4-2 - "Electromagnetic compatibility for industrial-process measurement and control equipment Part 2: Electrostatic discharge requirements."
- IEC 1000-4-3 - "Electromagnetic compatibility for industrial-process measurement and control equipment Part 3: Radiate electromagnetic field requirements."
- IEC 1000-4-4 - "Electromagnetic compatibility for industrial-process measurement and control equipment Part 4: Electrical fast transient/burst requirements."

SAFETY CERTIFICATIONS

ETL certified to meet Information Technology Equipment safety standards UL 1950, CSA 22.2 No. 950, and EN 60950.

ALPHA/BETA TEST DISCLAIMER

This ALPHA/BETA equipment has not been tested and found to comply with the emissions limits. These limits are designed to provide reasonable protection against harmful interference. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference with radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: 1) Reorient or relocate the receiving antenna. 2) Increase the separation between the equipment and the receiver. 3) Connect the equipment into an outlet on a circuit different from that to which the receiver is connected. 4) Consult FORE Systems, Inc. for more help. This equipment is to be used for evaluation purposes. Changes must not be made without the prior proper approval of FORE Systems, Inc.

This device has not been approved by the Federal Communications Commission. This device is not, and may not be, offered for sale or lease, or sold or leased until the approval of the FCC has been obtained.

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Preface

The intent of this manual is to supply users of the *ForeRunner*® ES-3810 Ethernet Workgroup Switch with the necessary information to successfully install and begin using the ES-3810. This document provides general product information, setup procedures, and network configuration examples. This manual was created for users with various levels of experience. If you have questions or problems with the installation, please contact FORE Systems Technical Assistance Center (TAC). (See page ii.)

Chapter Summaries

Chapter 1 - Introduction - Provides an overview of management options for the ES-3810 with emphasis on the Management Console. Also provided in this chapter are the electrical characteristics for the ES-3810.

Chapter 2 - Setup - Guides the user through the installation of the ES-3810 and provides an overview of the switch operation.

Chapter 3 - Hardware Configuration - Explains the layout of the ES-3810's chassis, port numbering scheme, available configurations and modules, and how to install or remove modules and power supplies.

Chapter 4 - Software Upgrade Procedures - Provides information about upgrading the operational software for the ES-3810.

Appendix A - Network Design - Provides information on IP Multicast support (IGMP), LAN Emulation, and network configurations.

Acronyms - Contains a list of common networking acronyms.

Glossary - Contains definitions for networking terms, both general and ATM-specific.

Technical Support

In the U.S.A., customers can reach FORE Systems' Technical Assistance Center (TAC) using any one of the following methods:

1. Select the "Support" link from FORE's World Wide Web page:

   http://www.fore.com/

2. Send questions, via e-mail, to:

   support@fore.com

3. Telephone questions to "support" at:

   800-671-FORE (3673) or **724-742-6999**

4. FAX questions to "support" at:

   724-742-7900

Technical support for customers outside the United States should be handled through the local distributor or via telephone at the following number:

+1 724-742-6999

No matter which method is used to reach FORE Support, customers should be ready to provide the following:

- A support contract ID number
- The serial number of each product in question
- All relevant information describing the problem or question

Typographical Styles

Throughout this manual, specific commands to be entered by the user appear on a separate line in bold typeface. In addition, use of the `Enter` or `Return` key is represented as `<ENTER>`. The following example demonstrates this convention:

```
cd \usr <ENTER>
```

Commands or file names that appear within the text of this manual are represented in the following style: "...the `fore_install` program will install this distribution"

Important Information Indicators

To call your attention to safety and otherwise important information that must be reviewed to insure correct and complete installation, as well as to avoid damage your system, FORE Systems utilizes the following *WARNING/CAUTION/NOTE* indicators.

WARNING statements contain information that is critical to the safety of the operator and/or the system. Do not proceed beyond a ***WARNING*** statement until the indicated conditions are fully understood or met. This information could prevent serious damage to the operator, the system, or currently loaded software, and will be indicated as:

WARNING!

Hazardous voltages are present. To lessen the risk of electrical shock and danger to personal health, follow the instructions carefully.

CAUTION statements contain information that is important for proper installation/operation. ***CAUTION*** statements can prevent possible equipment damage and/or loss of data and will be indicated as:

CAUTION

You risk damaging your equipment and/or software if you do not follow these instructions.

NOTE statements contain information that has been found important enough to be called to the special attention of the operator and will be set off from the text as follows:

NOTE

Steps 1, 3, and 5 are similar to the installation for the computer type above. Review the previous installation procedure before installation in your particular model.

Laser Notice

Class 1 Laser Product:
This product conforms to applicable requirements of 21 CFR 1040 at the date of manufacture.

Class 1 lasers are defined as products which do not permit human access to laser radiation in excess of the accessible limits of Class 1 for applicable wavelengths and durations. These lasers are safe under reasonably foreseeable conditions of operation. Do not view beam with optical instruments.

Every ES-3810 module with a single mode fiber optic interface contains a Class 1 laser.

Safety Precautions

For your protection, observe the following safety precautions when setting up your equipment:

- Follow all warnings and instructions marked on the equipment.
- Ensure that the voltage and frequency of your power source matches the voltage and frequency inscribed on the equipment’s electrical rating label.
- Never push objects of any kind through openings in the equipment. Dangerous voltages may be present. Conductive foreign objects could produce a short circuit that could cause fire, electric shock, or damage to your equipment.

Modifications to Equipment

Do not make mechanical or electrical modifications to the equipment. FORE Systems, Inc., is not responsible for regulatory compliance of a modified FORE product.

Placement of a FORE Systems Product

CAUTION

To ensure reliable operation of your FORE Systems product and to protect it from overheating, openings in the equipment must not be blocked or covered. A FORE Systems product should never be placed near a radiator or heat register.

Power Cord Connection

WARNING!

FORE Systems products are designed to work with single-phase power systems having a grounded neutral conductor. To reduce the risk of electrical shock, do not plug FORE Systems products into any other type of power system. Contact your facilities manager or a qualified electrician if you are not sure what type of power is supplied to your building.

WARNING!

Your FORE Systems product is shipped with a grounding type (3-wire) power cord. To reduce the risk of electric shock, always plug the cord into a grounded power outlet.

CHAPTER 1 Introduction

Based on a next-generation, distributed, store-and-forward switching architecture, the ES-3810 provides users with the ability to configure multiple switched Ethernet ports (both 10 and 100 Mbps) as needs grow. The ES-3810 also provides high-performance ATM server and backbone connections to take advantage of powerful advanced network management.

1.1 ES-3810 Configuration

The following figure shows the front panel of the ES-3810.

NOTE

The figure below represents ONE possible configuration of the ES-3810. Numerous other configurations are possible, depending on which ES--3810 modules are used.

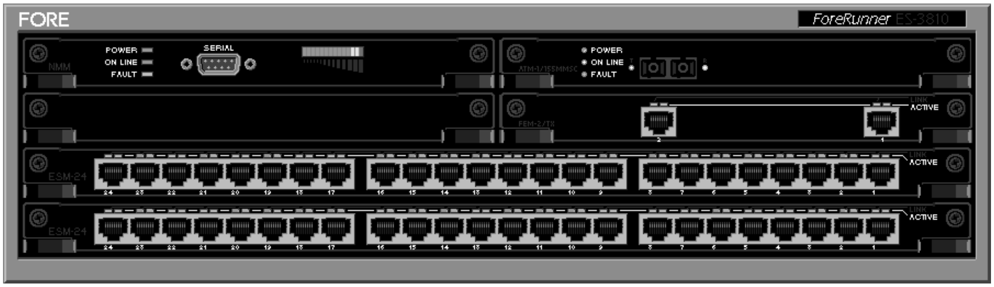


Figure 1.1 - The ES-3810 Ethernet Workgroup Switch

1.1.1 Dual Power Supply Chassis

The new ES-3810 chassis supports redundant, hot-swappable, load-sharing power supplies. Each supply utilizes its own power cord, allowing for separate electrical connections. For information about adding/removing power supplies, see Chapter 3.

With redundant power supplies installed, a single power supply failure on the ES-3810 will not cause the switch to stop functioning.

1.2 Processing Sequence

Upon power-up of the ES-3810, a series of sequenced operations are performed as follows:

NOTE The following sequence takes approximately 15 seconds to complete. The sequence must be completed before normal ES-3810 local console management activity may commence.

1. If a system configuration has been saved on the ES-3810, the NMM restores that configuration; otherwise, the NMM restores the factory default configuration. The configuration which the NMM restores is considered the "current configuration."
2. The NMM performs a Power-Up Self-Test (POST) on itself. If the POST reveals any problems, the appropriate information is displayed on the management console.
3. The NMM initializes itself using the current configuration, including:
   - IP parameters (i.e., IP address, subnet mask, primary gateway);
   - SNMP Agent Parameters (i.e., system name, contact, and location, access control list, authentication trap enable, and trap destination list);
   - Bridging parameters (i.e., initial filtering mode and maximum address database entry age);
   - Static ARP cache entries;
   - Static IP routing table entries;
   - VLAN database.

4. The NMM scans each slot for recognized modules (not including itself). For each module, the NMM performs the following start-up procedure:
   - The NMM performs a POST on the module.
   - If the POST reveals any problems, then the appropriate information is displayed on the management console. Furthermore, the NMM places the module in a reset state so that it does not interfere with the components of the system which are operating properly.
   - If the module POST does not reveal any problems, the NMM initializes the module using the configuration restored earlier in the start-up procedure.
5. The NMM starts the IP stack and SNMP agent.
6. The NMM starts the IGMP entity.
7. The NMM starts interface maintenance.
8. The NMM starts the management console by displaying the logon screen.

1.3 ES-3810 Specifications

- Single-power supply chassis specifications indicated by part number **ES-3810**. Dual-power supply chassis specifications indicated by part number **ES-3810/CH**.

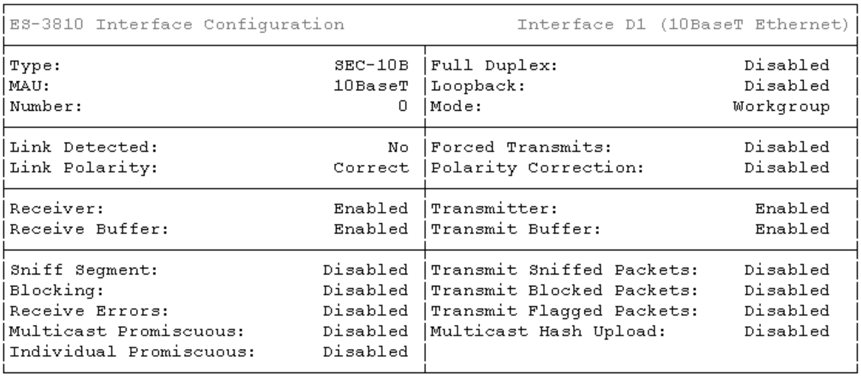
Table 1.1 - ES-3810 Specifications

System Specifications	
Aggregate Throughput	720,000 packets per second (pps)
Latency	61 µs per 64-byte packets (10Base-T)
Dimensions **ES-3810**	17.38" (44.1 cm) W x 4.88" (12.4 cm) H x 11.00" (27.9 cm) D
ES-3810/CH	17.35" (44.1 cm) W x 5.19" (13.2 cm) H x 12.64" (32.1 cm) D
Power **ES-3810**	90-264 volts, autosensing: 80 watts
ES-3810/CH	90-264 volts, autosensing: 110 watts
Operating Temp.	0 - 40° C
Weight	14.8 lb. (32.6 kg.)
Compliance	UL, TUV, CSA, FCC, CE
10Base Port Specifications	
Filter/Forward Speed	14,881 pps
Addresses/Port	4 (workgroup); 8,192 (segment)
Buffering/Port	256 kB
Operation	Full or half-duplex
Connector	RJ-45 (10BaseT); ST (10BaseFL)
Media	UTP Category 5 copper; 62.5/125µ multimode fiber
100Base Port Specifications	
Filter/Forward Speed	148,810 pps
Addresses/Port	4 (workgroup); 8,192 (segment)
Buffering/Port	1 Megabyte
Operation	Full or half-duplex
Connector	RJ-45 (TX); ST (FX)
Media	UTP Category 5 copper; 62.5/125µ multimode fiber

1.4 ES-3810 Settings

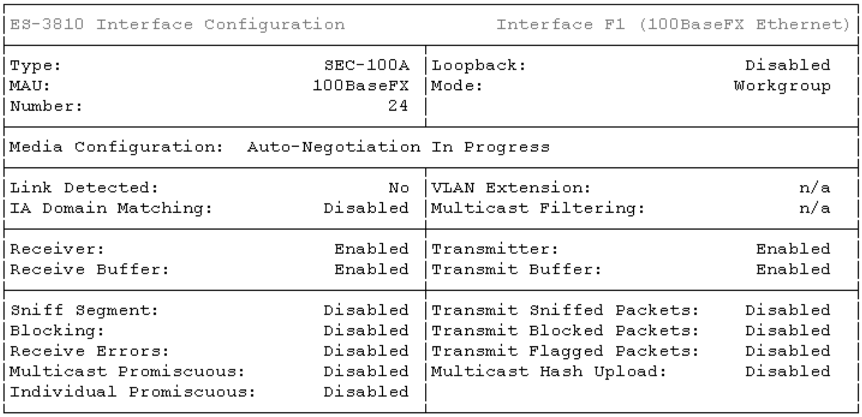
1.4.1 Factory Default Settings (Ethernet)

The following figures represent factory default settings of the ES-3810’s Ethernet ports. (Refer to the *ForeRunner ES-3810 Configuration Manual* for a description of each port parameter.)



```
|ES-3810 Interface Configuration              Interface D1 (10BaseT Ethernet)|
|Type:                          SEC-10B |Full Duplex:              Disabled  |
|MAU:                           10BaseT |Loopback:                 Disabled  |
|Number:                              0 |Mode:                    Workgroup  |
|Link Detected:                      No |Forced Transmits:         Disabled  |
|Link Polarity:                 Correct |Polarity Correction:      Disabled  |
|Receiver:                      Enabled |Transmitter:               Enabled  |
|Receive Buffer:                Enabled |Transmit Buffer:           Enabled  |
|Sniff Segment:                Disabled |Transmit Sniffed Packets:  Disabled  |
|Blocking:                     Disabled |Transmit Blocked Packets:  Disabled  |
|Receive Errors:               Disabled |Transmit Flagged Packets:  Disabled  |
|Multicast Promiscuous:        Disabled |Multicast Hash Upload:     Disabled  |
|Individual Promiscuous:       Disabled |                                    |
```

Figure 1.2 - 10BaseT Factory Default Settings



```
|ES-3810 Interface Configuration           Interface F1 (100BaseFX Ethernet)|
|Type:                         SEC-100A |Loopback:                 Disabled  |
|MAU:                         100BaseFX |Mode:                    Workgroup  |
|Number:                             24 |                                    |
|Media Configuration:  Auto-Negotiation In Progress                          |
|Link Detected:                      No |VLAN Extension:                 n/a |
|IA Domain Matching:           Disabled |Multicast Filtering:            n/a |
|Receiver:                      Enabled |Transmitter:               Enabled  |
|Receive Buffer:                Enabled |Transmit Buffer:           Enabled  |
|Sniff Segment:                Disabled |Transmit Sniffed Packets:  Disabled  |
|Blocking:                     Disabled |Transmit Blocked Packets:  Disabled  |
|Receive Errors:               Disabled |Transmit Flagged Packets:  Disabled  |
|Multicast Promiscuous:        Disabled |Multicast Hash Upload:     Disabled  |
|Individual Promiscuous:       Disabled |                                    |
```

Figure 1.3 - 100BaseFX Factory Default Settings

CHAPTER 2 Setup

The following information describes the handling and installation of the *ForeRunner* ES-3810 prior to operation.

2.1 Introduction

Before installing the ES-3810, there are several important factors that must be taken into consideration, depending on the type of installation site. The following sections discuss in detail how to install a *ForeRunner* ES-3810 switch and any prerequisites to the installation.

CAUTION

It is very important to read through and understand ALL of Chapter 2 and Chapter 3 before attempting to power on the unit.

2.2 Unpacking

Upon receipt of, and before opening the ES-3810, inspect the package for any damage that might have occurred during shipping. If the package shows any signs of external damage or rough handling, notify your carrier’s representative.

When unpacking the ES-3810, be sure to keep all original packing materials.

NOTE

All products returned to FORE Systems, under warranty, must be packed in their original packing materials.

2.2.1 Inventorying the Unit

A complete inventory of the ES-3810 should be performed before proceeding to further sections of this manual. The ES-3810 package should include:

- One (1) *ForeRunner* ES-3810 Ethernet Workgroup Switch System
- Power cords[1]
- Rack-mount accessory kit (with two brackets and eight screws)
- One (1) *ForeRunner ES-3810 Installation and Maintenance Manual* (this manual)
- One (1) *ForeRunner ES-3810 Configuration Manual*
- One (1) Console Management serial cable

NOTE

If any of the following components are not present, please contact FORE Systems, Inc.

---

[1] Up to four power cords may ship with the ES-3810. Two of the power cords are for use with U.S. power, and two are for use with Europe EC power. One of each type of power cord ships with each power supply that is ordered.

2.3 Electrical Considerations

The following items should be considered when setting up the switch:

CAUTION

Consideration should be given to the connection of the equipment to the supply circuit and the effect that the overloading of circuits could have on overcurrent protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern.

CAUTION

Reliable grounding of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connections to the branch (i.e., use of power strips).

2.4 Installation Options

The ES-3810 is designed to be either rack-mounted or placed on the desktop. FORE Systems recommends that the maximum operating ambient temperature (T_{mra}) of the ES-3810 not exceed 40° C. Consideration must be made if an ES-3810 is to be installed in a closed or multi-unit rack assembly, because the operating ambient temperature of the rack environment may be greater than the room ambient temperature.

NOTE

FORE Systems recommends mounting the ES-3810 with the wiring side forward. More LEDs are visible from this view and cable dressings and attachments can be easily verified.

2.4.1 Clearance Requirements

When installing the ES-3810, both sides of the unit should be clear from any obstructions to allow air flow through the unit.

The ES-3810 is designed to be installed either as a stand-alone unit or as a rack-mount unit using two brackets and eight screws included in the accessory kit (refer to Section 2.2.1). The standard unit can be installed with either the front or back of the unit facing forward. See Table 1.1 in Chapter 1 for information about the dimensions of the ES-3810 chassis (single and dual power supply models).

2.4.2 Installing Rack-Mount Brackets

Appropriate tools (i.e., screwdrivers) are required to install the rack-mount brackets. A set of two rack-mount brackets is supplied with each ES-3810. Each bracket is secured to the chassis using two screws, attached to either the side or the bottom of the chassis, but not both.

The ES-3810 can be placed with either the front or the back of the unit facing forward. Figure 2.1 shows the installation of one of the rack-mount brackets on a single power supply ES-3810. Install one bracket at each corner of the unit as shown.

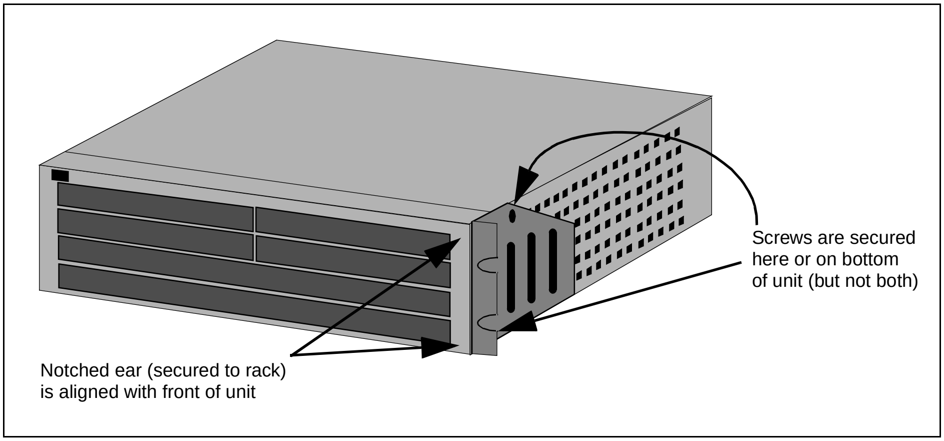


Figure 2.1 - Positioning a Rack-Mount Bracket on the ES-3810 (ES-3810)

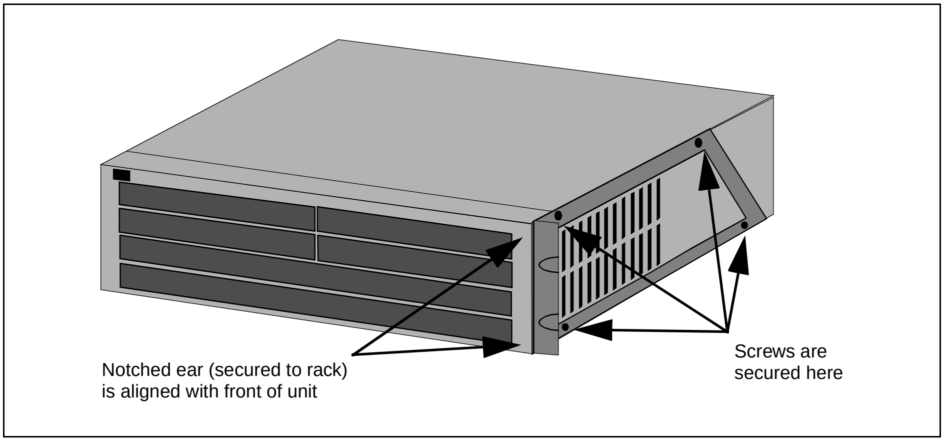


Figure 2.2 - Positioning a Rack-Mount Bracket on the ES-3810 (ES-3810/CH)

WARNING!

The use of screws other than those provided to attach the rack-mount brackets could result in damage to the unit.

2.5 Connecting the Management Station

The management console provides a menu-based user interface that utilizes a VT-100 terminal or VT-100 terminal emulator (e.g., Windows 3.x Terminal, ProComm PCPLUS). The serial interface of the ES-3810 connects directly to either the DTE interface of the ASCII terminal or a serial port of the personal computer or workstation running the terminal emulation package.

A management console should be attached when the ES-3810 is turned on so that any power-up errors may be detected. If a management station is not connected to the console port, the ES-3810 still operates using either the factory default settings detailed in Section 1.4 or the last saved settings which are restored during the power up sequence.

The ES-3810 can also be reached via Telnet. For more information about connecting to the ES-3810 via Telnet, see the *ForeRunner ES-3810 Configuration Manual*.

NOTE

If the NMM/ NMC's SNMP-based management or IGMP support is to be used, a console connection is required the first time the NMM/ NMC is brought on-line since an IP address, subnet mask and possibly a gateway must be defined.

2.5.1 Connecting the Management Console Cable

The first step in the installation of the management station is to connect the included 9-pin null modem serial cable to the ES-3810. The connection interface is located on the left-hand side of the management module. Once the serial cable is secured to the ES-3810, connect the other end to either a serial port of the personal computer or workstation or the DTE interface of an ASCII terminal. Example wiring information for wiring a PC COM port cable to an ES-3810 is indicated in Table 2.1. To connect to a PC's COM port (also a DTE) the cable from table 2.1 (RS232 connector type on the NMM/ NMC module: Male chassis, 9 pin D, wired as DTE) needs to be crossed.

Table 2.1 - Description of the Signals

Signal Description	**EIA RS232**	**ITU V.24**	**Pin Number on DB9S**	**Data Direction on 3810**
TxD Transmit Data	BA	103	3	OUT
RxD Received Data	BB	104	2	IN
RTS Request to Send	CA	105	7	OUT, Active
CTS Clear to Send	CB	106	8	IN
DSR Data-Set Ready	CC	107	6	IN
GND Signal Ground	AB	102	5	-
DCD Data-Terminal Ready	CF	109	1	IN
DTR Data-Terminal Ready	CD	108.2	4	OUT, Active

NOTE

CTS, DSR and DCD need an active signal on the ES-3810 input, otherwise the console will not work. **When CTS is inactive (-12V) and DSR is active (+12V), the unit cannot boot or reboot. The dial-in modem may need to be configured correctly to avoid a deadlock situation**.

2.5.2 Configuring the Management Station

Table 2.2 details the connection parameters common to most methods of terminal emulation. Please consult the respective user’s manual for any unique characteristics of the emulation package you are using.

Table 2.2 - Common Connection Parameters for Terminal Emulation

Parameter	Setting
Baud	9600
Data Bits	8
Stop Bits	1
Parity	None
Flow Control	Off
Connector	COM1 or COM2

2.5.3 Logging on to the ES-3810

Upon the first successful power-up of the ES-3810, you will be prompted for a username. Enter one of the following usernames according to the access privileges you want:

public	Grants read only privileges to objects that are accessible through the ES-3810’s local management console (e.g., port counters can be viewed, but port parameters can not be changed).
private	Grants read / write privileges to all managed objects that are accessible through the ES-3810’s local management console.

NOTE

Logging on as `private` requires the use of a password. The default password is `fore`.

See Chapter 1 of the *ForeRunner ES-3810 Configuration Manual* for more detailed information about access privileges.

CHAPTER 3 Hardware Configuration

3.1 ES-3810 Design

The ES-3810 enclosure supports a total of six modules. All six slots in the ES-3810 chassis can support half-width modules, while only slots A, B, C, and D can support full-width modules. Card guides are located on both sides of the ES-3810 enclosure to facilitate module installation by guiding a module into an available slot.

Modules "plug into" the system by mating with a connector on the system backplane. See Section 3.7 for more information about adding and removing modules.

NOTE

When adding a module to the *ForeRunner* ES-3810, except in the case of an ESM-24, the individual port configurations for all ports will be returned to the factory defaults. If special port configurations have been assigned they should be noted before the module upgrade is performed. When installing an ESM-24 in a slot previously containing an ESM-24, the "last saved" configuration will be applied to the module.

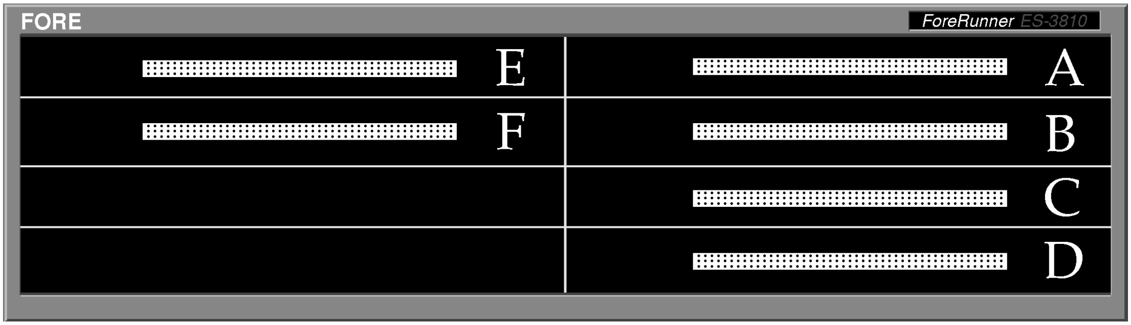


Figure 3.1 - ES-3810 Backplane: Card Slot Locations

3.2 Port Numbering

Ports are numbered in the ES-3810 according first to their slot position and second to their position relative to other ports on the same module. Ports on modules in slot A are numbered A# (where # represents the port number relative only to the module), ports on modules in slot B are numbered B#, etc.

For example, the port on an ATM uplink module in slot A is numbered port A1. Port one on a FEM-2/TX in slot F is numbered port F1. See Figure 3.2 for more examples.

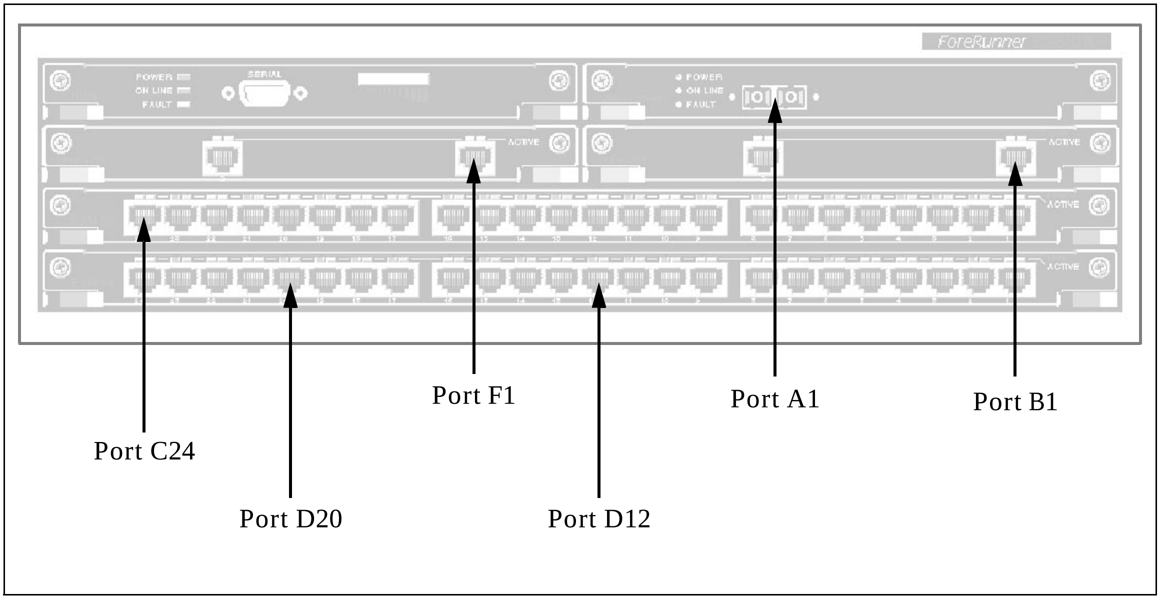


Figure 3.2 - Example of Port Numbering on the ES-3810

3.3 ES-3810 Management Modules

The minimum configuration of the ES-3810 consists of the base unit with a network management module (NMM) and 24 ports of 10 Mbps switched Ethernet or a network management controller (NMC) and 24 ports of 10 Mbps switched Ethernet. The availability of add-on modules provides flexible and scalable Ethernet switching and backbone connectivity solutions that can be customized to meet the user's needs. The following modules are available for the ES-3810.

3.3.1 NMC-2/155 (Network Management Controller)

The NMC-2/155, as shown in Figure 3.3, is a full-width module. It provides both a management console and SNMP-based management. It has dual OC-3c uplinks and can be supported by either a single or dual power supply.

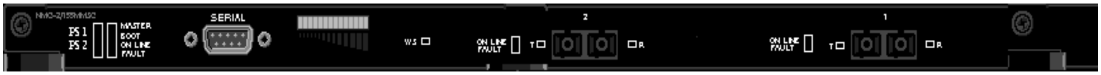


Figure 3.3 - Network Management Controller Module

3.3.1.1 NMC Status LEDs

Located on the left side of the 9-pin serial interface are eight vertical status LEDs which illuminate as follows:

PS1	Illuminates GREEN when power supply one is installed and operating. Illuminates AMBER when power supply one is installed but not operating. When both LEDs are not illuminated, then power supply one is not installed.
PS2	Illuminates GREEN when power supply two is installed and operating. Illuminates AMBER when power supply two is installed but not operating. When both LEDs are not illuminated, then power supply two is not installed.
MASTER	Illuminates GREEN during the power-on self-test (POST). (This LED is reserved for functionality in future releases.)
BOOT	Illuminates AMBER during POST. (This LED is reserved for functionality in future releases.)
ON LINE	Illuminates GREEN after applying power. Signifies that the processor has come up, basic electrical connections are functional, and the NMC has passed its power-on self-test (POST).
FAULT	Illuminates RED if a processor failure is detected. If this LED illuminates RED, please call FORE Systems' Technical Assistance Center.

To the immediate right of the 9-pin serial interface, there is a bandwidth utilization display and a fail-over status LED, which illuminate as follows:

Bandwidth Utilization Display	(See Section 3.3.1.2 for an explanation of this feature.)
WD	If this LED illuminates BLUE, contact FORE Systems' Technical Assistance Center (TAC); a software timeout event may have occurred. (See on page ii.)

On either side of the dual OC-3c uplinks, there are a total of four status LEDs, which illuminate as follows (described from left to right):

ON LINE	Illuminates GREEN after applying power. Signifies that the processor has come up, basic electrical connections are functional, and the NMC has passed its power-on self-test.
FAULT	Illuminates RED if there is a processor failure detected. If this LED illuminates RED, please call FORE Systems' Technical Assistance Center.
T (transmit)	Illuminates GREEN to indicate the transmission of data.
R (receive)	Illuminates GREEN to indicate the receipt of data, RED to indicate loss of carrier, and YELLOW to indicate alarms.

3.3.1.2 Bandwidth Utilization Display

The Bandwidth Utilization Display is located on the right side of the 9-pin serial interface of the NMC. This row of LEDs, as shown in Figure 3.4, indicates the volume of packets (in bps) entering and leaving the ES-3810. The NMC periodically samples the transmit and receive byte counters of each supported interface to determine the total, aggregate bandwidth being utilized. The display logarithmically indicates the moving average, over a two second period, of the total, aggregate bandwidth. The right-most LED comprising the display represents the maximum total, aggregate bandwidth the system can support. This maximum not only depends on the number and type of interfaces, but the configuration of those interfaces.

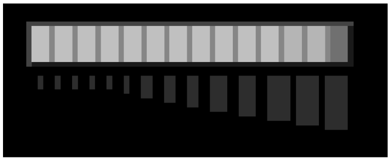


Figure 3.4 - Bandwidth Utilization Display on the NMC

3.3.2 NMM (Network Management Module)

The NMM, as shown in the Figure 3.5, is a half-width module. It provides both a management console and SNMP-based management.

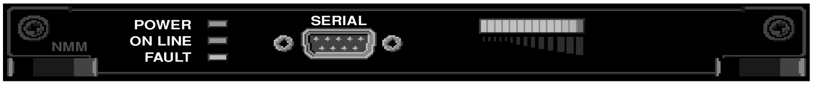


Figure 3.5 - The Network Management Module

3.3.2.1 NMM Memory Requirements

CAUTION

Software versions 4.2.0 and higher will not operate on an NMM with 4MB of DRAM.

The NMM requires eight megabytes of DRAM to run software versions 4.2.0 or higher. To upgrade a 4MB NMM to software version 4.2.0 or later, the NMM's memory must be upgraded to 8MB. Instructions for performing this memory upgrade are included with the upgrade kit (NMM-UPG). Contact FORE Systems or see your distributor to obtain this upgrade kit.

3.3.2.2 NMM Status LEDs

Located on the left side of the 9-pin serial interface are three vertical status LEDs which illuminate as follows:

POWER	Illuminates GREEN and signifies active POWER. If the unit is turned on and this LED does not illuminate, any of the following could apply: the NMM has blown a fuse, the power supply is damaged, the power cable is damaged, or the power cable is disconnected.
ON LINE	Illuminates GREEN after applying power. Signifies that the processor has come up, basic electrical connections are functional, and the NMM has passed its power-on self-test.
FAULT	Illuminates AMBER if there is a processor failure detected. If this LED illuminates AMBER, please call FORE Systems' Technical Assistance Center.

3.3.2.3 Bandwidth Utilization Display

The Bandwidth Utilization Display is located on the right side of the 9-pin serial interface of the NMM. See page 6 for more details.

3.3.3 ESM-16 (16-port, Console Managed, Ethernet Switch Module)

Figure 3.6 depicts the ESM-16, a console managed, 16-port, 10 Mbps module.

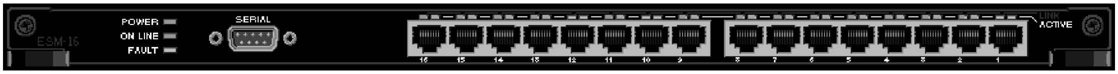


Figure 3.6 - The ESM-16 Module

CAUTION

DO NOT install more than one ESM-16 in an ES-3810 at any time. Each module tries to control the switch, which can cause permanent damage to both the modules and the ES-3810.

NOTE

If using an ESM-16 for console management, the maximum configuration is 88 10 Mbps ports (one ESM-16 plus three ESM-24s).

3.3.3.1 ESM-16 Status LEDs

Located on the left hand side of the 9-pin serial connector, there are three vertical LEDs which illuminate as follows:

POWER	Illuminates GREEN and signifies active POWER. If the unit is turned on and this LED does not illuminate, either the power supply is damaged or the power cable is either damaged or disconnected.
ON LINE	Illuminates GREEN after applying power. Signifies that the processor has come up, basic electrical connections are functional, and the ESM-16 module itself is recognized by the system.
FAULT	Illuminates AMBER if there is a processor failure detected (i.e., the processor is likely dead). If this LED ever comes up AMBER, please call FORE Systems' Technical Assistance Center.

3.3.3.2 ESM-16 Port LEDs

Each port of an ESM-16 has 2 LEDs associated with it, a LINK LED and an ACTIVE LED. These LEDs illuminate as follows:

LINK	Illuminates GREEN if a valid cable is connected to the port and the end station is powered on. If the LINK LED does not illuminate, the cable is either bad or crossed. Additionally, this LED will blink continually if the port fails initialization diagnostics.
ACTIVE	Illuminates AMBER and flashes to represent traffic on the port. If the LED does not illuminate, there is no activity on the port.

3.4 ES-3810 Workgroup Modules

3.4.1 ESM-24 (24-port, Ethernet Switch Module)

The ESM-24 module, as shown in Figure 3.7, provides 24 ports of 10 Mbps switched Ethernet. The ESM-24 supports four MAC addresses per port.

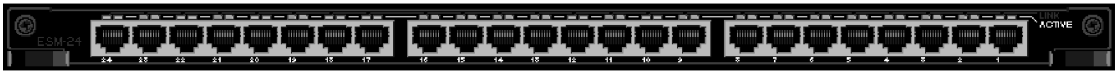


Figure 3.7 - The ESM-24 Module

3.4.1.1 ESM-24 Port LEDs

Each port of an ESM-24 has two LEDs associated with it, a LINK LED and an ACTIVE LED. These LEDs illuminate as follows:

LINK	Illuminates GREEN if a valid cable is connected to the port and the endstation is powered on. If the LINK LED does not illuminate, the cable is either crossed or defective. Additionally, this LED will blink continually if the port fails initialization diagnostics.
ACTIVE	Illuminates AMBER and flashes to represent traffic on the port. If the LED does not illuminate, there is no activity on the port.

3.4.2 ESM-12/FL (12-port Fiber ST, Ethernet Switch Module)

Figure 3.8 shows a 10Base-FL, 12-port, full-width add-on 10 Mbps module. The ESM-12/FL supports four MAC addresses per port.

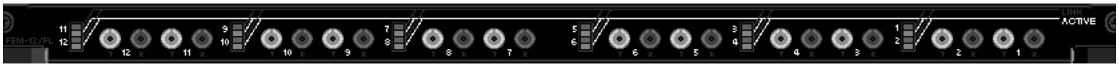


Figure 3.8 - The ESM-12/FL Module

3.4.2.1 ESM-12/FL Port LEDs

Each port of an ESM-12/FL has two LEDs associated with it, a LINK LED and an ACTIVE LED. These LEDs illuminate as follows:

LINK	The LINK LED is above the ACTIVE LED. It illuminates GREEN if a valid cable is connected to the port and the endstation is powered on. If the LINK LED does not illuminate, the cable is either crossed or defective. Additionally, this LED will blink continually if the port fails initialization diagnostics.
ACTIVE	The ACTIVE LED is below the LINK LED. It illuminates AMBER and flashes to represent traffic on the port. If the LED does not illuminate, there is no activity on the port.

3.4.3 FEM-2/TX (2-port TX, Fast Ethernet Module)

Figure 3.9 shows a 100Base-TX two-port, half-width add-on 100 Mbps module.

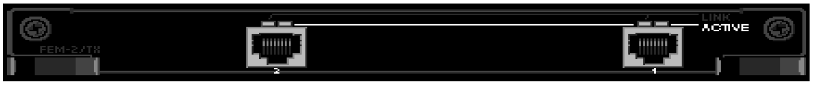


Figure 3.9 - The FEM-2/TX Module

3.4.3.1 FEM-2/TX Port LEDs

Each port of an FEM-2/TX has two LEDs associated with it, a LINK LED and an ACTIVE LED. These LEDs illuminate as follows:

LINK	Illuminates GREEN if a valid cable is connected to the port and the endstation is powered on. If the LINK LED does not illuminate, the cable is either crossed or defective. Additionally, this LED will blink continually if the port fails initialization diagnostics.
ACTIVE	Illuminates AMBER and flashes to represent traffic on the port. If the LED does not illuminate, there is no activity on the port.

3.4.4 FEM-2/FX (2-port FX, Fast Ethernet Module)

Figure 3.10 shows a 100Base-FX two-port, half-width add-on 100 Mbps module.

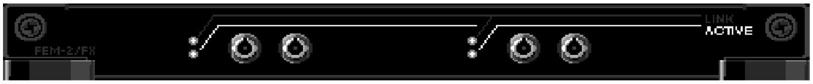


Figure 3.10 - The FEM-2/FX Module

3.4.4.1 FEM-2/FX Port LEDs

Each port of an FEM-2/FX has two LEDs associated with it, a LINK LED and an ACTIVE LED. These LEDs illuminate as follows:

LINK	Illuminates GREEN if a valid cable is connected to the port and the endstation is powered on. If the LINK LED does not illuminate, the cable is either crossed or defective. Additionally, this LED will blink continually if the port fails initialization diagnostics.
ACTIVE	Illuminates AMBER and flashes to represent traffic on the port. If the LED does not illuminate, there is no activity on the port.

3.4.5 FEM-8A/TX (8-port TX, Fast Ethernet Module)

Figure 3.11 shows a 10/100Base-TX, eight-port, full-width 100 Mbps module. The FEM-8A/TX supports four MAC addresses per port.

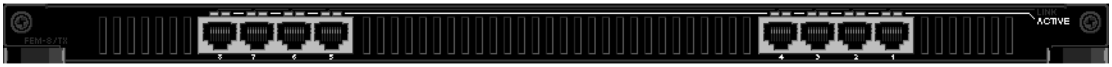


Figure 3.11 - The FEM-8A/TX Module

3.4.5.1 FEM-8A/TX Port LEDs

Each port of an FEM-8A/TX has two LEDs associated with it, a LINK LED and an ACTIVE LED. These LEDs illuminate as follows:

LINK	Illuminates GREEN if a valid cable is connected to the port and the endstation is powered on. If the LINK LED does not illuminate, the cable is either crossed or defective. Additionally, this LED will blink continually if the port fails initialization diagnostics.
ACTIVE	Illuminates AMBER and flashes to represent traffic on the port. If the LED does not illuminate, there is no activity on the port.

CAUTION

Installing more than two (2) FEM-8A/TX modules in an ES-3810 single-power supply chassis at any one time exceeds the power and cooling capacity of the unit.

3.5 ES-3810 Segment Modules

3.5.1 FSM-8/FX (8-port FX, Segment Switch Module)

Figure 3.12 shows a 10/100Base-FX, eight-port, full-width segment switch module. An 8192-entry bridge table is supported by each module.

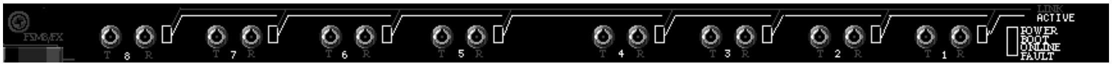


Figure 3.12 - The FSM-8/FX Module

3.5.1.1 FSM-8/FX Processor LEDs

The FSM-8/FX has four LEDs that indicate the status of its processor: POWER, BOOT, ON LINE, and FAULT. These LEDs illuminate as follows:

POWER	Illuminates GREEN and signifies active POWER. If the unit is turned on and this LED does not illuminate, either the power supply is damaged or the power cable is either damaged or disconnected.
BOOT	Illuminates AMBER while the module processor is loading firmware from the NMM module after a reset or power-up.
ON LINE	Illuminates GREEN after applying power and the module processor is operational. This signifies that the module is working properly.
FAULT	Illuminates RED if a failure is detected. If this LED comes up RED please call FORE Systems Technical Assistance Center. If the LED does not illuminate, the module is OK. The LED will come on during the power-up diagnostic test.

3.5.1.2 FSM-8/FX Port LEDs

Each port of an FSM-8/FX has four LEDs associated with it: LINK, ACTIVE, DUPLEX, and SPEED. These LEDs illuminate as follows:

LINK	Illuminates GREEN if a valid cable is connected to the port and the endstation is powered on. If the LINK LED does not illuminate, the cable is either crossed or defective.
ACTIVE	Illuminates GREEN if a valid cable is connected to the port and the endstation is powered on. If the LINK LED does not illuminate, the cable is either crossed or defective. Additionally, this LED will blink continually if the port fails initialization diagnostics.
DUPLEX	Illuminates GREEN to represent Full Duplex mode. If the LED does not illuminate, the port is set to Half Duplex mode.
SPEED	Illuminates GREEN to represent 100 Mbps mode. If the LED does not illuminate, the port is set to 10 Mbps mode.

CAUTION

Installing more than two (2) FSM-8/FX modules in an ES-3810 single-power supply chassis at any one time exceeds the power and cooling capacity of the unit.

3.5.2 FSM-8/TX (8-port TX, Segment Switch Module)

Figure 3.13 shows a 10/100Base-TX, eight-port, full-width segment switch module. A 4000-entry bridge table is supported by each module.

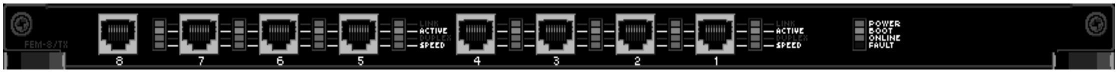


Figure 3.13 - The FSM-8/TX Module

3.5.2.1 FSM-8/TX Processor LEDs

The FSM-8/TX has four LEDs that indicate the status of its processor: POWER, BOOT, ON LINE, and FAULT. These LEDs illuminate as follows:

POWER	Illuminates GREEN and signifies active POWER. If the unit is turned on and this LED does not illuminate, either the power supply is damaged or the power cable is either damaged or disconnected.
BOOT	Illuminates AMBER while the module processor is loading firmware from the NMM module after a reset or power-up.
ON LINE	Illuminates GREEN after applying power and the module processor is operational. This signifies that the module is working properly.
FAULT	Illuminates RED if a failure is detected. If this LED comes up RED please call FORE Systems Technical Assistance Center. If the LED does not illuminate, the module is OK. The LED will come on during the power-up diagnostic test.

3.5.2.2 FSM-8/TX Port LEDs

Each port of an FSM-8/TX has four LEDs associated with it: LINK, ACTIVE, DUPLEX, and SPEED. These LEDs illuminate as follows:

LINK	Illuminates GREEN if a valid cable is connected to the port and the endstation is powered on. If the LINK LED does not illuminate, the cable is either crossed or defective. Additionally, this LED will blink continually if the port fails initialization diagnostics.
ACTIVE	Illuminates AMBER and flashes to represent traffic on the port. If the LED does not illuminate, there is no activity on the port.
DUPLEX	Illuminates GREEN to represent Full Duplex mode. If the LED does not illuminate, the port is set to Half Duplex mode.
SPEED	Illuminates GREEN to represent 100 Mbps mode. If the LED does not illuminate, the port is set to 10 Mbps mode.

CAUTION

Installing more than two (2) FSM-8/TX modules in an ES-3810 single-power supply chassis at any one time exceeds the power and cooling capacity of the unit.

3.5.3 SSM-12/FL (12-port, Segment Switch Module)

Figure 3.15 shows a 10Mbps, 12-port, full-width segment switch module.

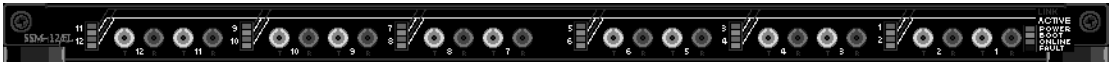


Figure 3.14 - The SSM-12/FL Module

3.5.3.1 SSM-12/FL Processor LEDs

The SSM-12/FL has four LEDs that indicate the status of its processor: POWER, BOOT, ON LINE, and FAULT. These LEDs illuminate as follows:

POWER	Illuminates GREEN and signifies active POWER. If the unit is turned on and this LED does not illuminate, either the power supply is damaged or the power cable is either damaged or disconnected.
BOOT	Illuminates AMBER while the module processor is loading firmware after a reset or power-up.
ON LINE	Illuminates GREEN after applying power and the module processor is operational. This signifies that the module is working properly.
FAULT	Illuminates RED if a failure is detected. If this LED comes up RED please call FORE Support. If the LED does not illuminate, the module is OK. The LED will come on during the power-up diagnostic test.

3.5.3.2 SSM-12/FL Port LEDs

Each port of an SSM-12/FL has two LEDs associated with it, a LINK LED and an ACTIVE LED.

LINK	Illuminates GREEN if a valid cable is connected to the port and the end station is powered on. If the LINK LED does not illuminate, the cable is either bad or crossed. Blinks continually if the port fails initialization diagnostics, indicating that the port is bad.
ACTIVE	Illuminates AMBER and flashes to represent traffic on the port. If the LED does not illuminate, there is no activity on the port.

3.5.4 SSM-16 (16-port, Segment Switch Module)

Figure 3.15 shows a 10-Base-T, 16-port, full-width segment switch module.

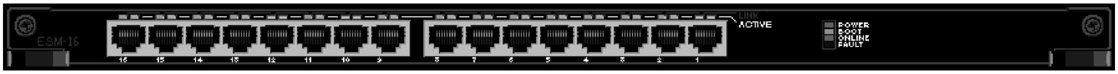


Figure 3.15 - The SSM-16 Module

3.5.4.1 SSM-16 Processor LEDs

The SSM-16 has four LEDs that indicate the status of its processor: POWER, BOOT, ON LINE, and FAULT. These LEDs illuminate as follows:

POWER	Illuminates GREEN and signifies active POWER. If the unit is turned on and this LED does not illuminate, either the power supply is damaged or the power cable is either damaged or disconnected.
BOOT	Illuminates AMBER while the module processor is loading firmware from the NMM module after a reset or power-up.
ON LINE	Illuminates GREEN after applying power and the module processor is operational. This signifies that the module is working properly.
FAULT	Illuminates RED if a failure is detected. If this LED comes up RED please call FORE Support. If the LED does not illuminate, the module is OK. The LED will come on during the power-up diagnostic test.

3.5.4.2 SSM-16 Port LEDs

Each port of an SSM-16 has two LEDs associated with it, a LINK LED and an ACTIVE LED. These LEDs illuminate as follows:

LINK	Illuminates GREEN if a valid cable is connected to the port and the endstation is powered on. If the LINK LED does not illuminate, the cable is either bad or crossed. Blinks continually if the port fails initialization diagnostics, indicating that the port is bad.
ACTIVE	Illuminates AMBER and flashes to represent traffic on the port. If the LED does not illuminate, there is no activity on the port.

3.6 ES-3810 ATM Uplink Modules

3.6.1 ATM-1/155MMST

Figure 3.16 shows a one-port, half-width add-on 155 Mbps OC-3 Multimode ATM uplink module with ST connectors.

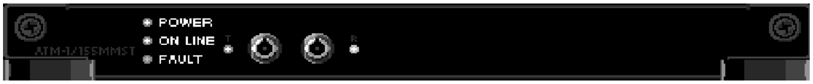


Figure 3.16 - The Multimode ATM Uplink Module with ST Connectors

3.6.1.1 ATM-1/155MMST LEDs

The five LEDs on the ATM-1 / 155MMST uplink illuminate as follows:

POWER	Illuminates GREEN and signifies active POWER. If the unit is on and this LED does not illuminate, either the power supply or power cable are damaged, or the power cable is disconnected.
ON LINE	Illuminates GREEN after the processor has come up, basic electrical connections are functional, and the ATM uplink module itself is recognized by the system.
FAULT	Illuminates AMBER if there is a processor failure detected (i.e., the processor is likely defective). If this LED illuminates AMBER, please call FORE Systems Technical Assistance Center.
T (transmit)	Illuminates GREEN to indicate the transmission of data.
R (receive)	Illuminates RED to indicate loss of carrier, YELLOW to indicate alarms, and GREEN to indicate the receipt of data.

3.6.2 ATM-1/155MMSC

Figure 3.17 shows a one-port, half-width add-on 155 Mbps OC-3 Multimode ATM uplink module with SC connectors.

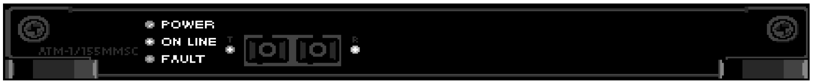


Figure 3.17 - The Multimode ATM Uplink Module with SC Connectors

3.6.2.1 ATM-1/155MMSC LEDs

The five LEDs on the ATM-1/155MMSC uplink illuminate as follows:

POWER	Illuminates GREEN and signifies active POWER. If the unit is on and this LED does not illuminate, either the power supply or power cable are damaged, or the power cable is disconnected.
ON LINE	Illuminates GREEN after the processor has come up, basic electrical connections are functional, and the ATM uplink module itself is recognized by the system.
FAULT	Illuminates AMBER if there is a processor failure detected (i.e., the processor is likely defective). If this LED illuminates AMBER, please call FORE Systems' Technical Assistance Center.
T (transmit)	Illuminates green to indicate the transmission of data.
R (receive)	Illuminates red to indicate loss of carrier, yellow to indicate alarms and green to indicate the receipt of data.

3.6.3 ATM-1/155SMSC

Figure 3.18 shows a one-port, half-width add-on 155 Mbps OC-3 single mode ATM uplink module with SC connectors.

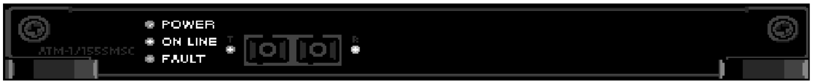


Figure 3.18 - The Single Mode ATM Uplink Module with SC Connectors

3.6.3.1 ATM-1/155SMSC LEDs

The five LEDs on the ATM-1/155MMSC uplink illuminate as follows:

POWER	Illuminates GREEN and signifies active POWER. If the unit is on and this LED does not illuminate, either the power supply or power cable are damaged, or the power cable is disconnected.
ON LINE	Illuminates GREEN after the processor has come up, basic electrical connections are functional, and the ATM uplink module itself is recognized by the system.
FAULT	Illuminates AMBER if there is a processor failure detected (i.e., the processor is likely defective). If this LED illuminates AMBER, please call FORE Systems' Technical Assistance Center.
T (transmit)	Illuminates green to indicate the transmission of data.
R (receive)	Illuminates red to indicate loss of carrier, yellow to indicate alarms and green to indicate the receipt of data.

3.6.4 ATM-1/155UTP

Figure 3.19 shows a one-port, half-width, add-on 155 Mbps ATM uplink module with a UTP connector.

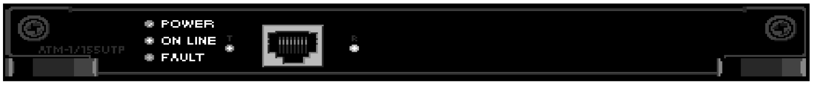


Figure 3.19 - The UTP ATM Uplink Module with RJ-45 Connector

3.6.4.1 ATM-1/155UTP LEDs

The five LEDs on the ATM-1/155UTP uplink illuminate as follows:

POWER	Illuminates GREEN and signifies active POWER. If the unit is on and this LED does not illuminate, either the power supply or power cable are damaged, or the power cable is disconnected.
ON LINE	Illuminates GREEN after the processor has come up, basic electrical connections are functional, and the ATM uplink module itself is recognized by the system.
FAULT	Illuminates AMBER if there is a processor failure detected (i.e., the processor is likely defective). If this LED illuminates AMBER, please call FORE Systems' Technical Assistance Center.
T (transmit)	Illuminates green to indicate the transmission of data.
R (receive)	Illuminates red to indicate loss of carrier, yellow to indicate alarms and green to indicate the receipt of data.

3.7 Removing and Installing Modules

The ES-3810's individual modules can be added or removed, if necessary. See the following sections for more detailed information.

3.7.1 Disconnecting Full-width Modules

The steps required to remove a full-width module from the ES-3810 are as follows:

NOTE

When adding a module to the *ForeRunner* ES-3810, except in the case of an ESM-24, the individual port configurations for all ports will be returned to the factory defaults. If special port configurations have been assigned they should be noted before the module upgrade is performed. When installing an ESM-24 in a slot previously containing an ESM-24, the "last saved" configuration will be applied to the module.

1. Turn-off the ES-3810 switch.
2. On the module being removed, turn the two thumbscrews to the left until they spin loosely.
3. Once loose, use the two ejector handles (located directly below the two thumbscrews) to remove the module.

At this point, you can insert a new module into the empty slot or leave it vacant. If you choose to insert a new module, see the instructions in Section 3.7.2. If you choose to leave the slot vacant, cover it with an appropriately sized blank bezel according to the following:

1. Place the blank bezel over the empty slot in the ES-3810 chassis.
2. Turn the two thumbscrews on either side of the bezel to the right until the bezel is completely secure over the slot.

3.7.2 Connecting Full-width Modules

The steps required to install a full-width module in the ES-3810 are as follows:

1. Turn-off the ES-3810 switch.
2. If a blank bezel covers the slot in which the new module will reside, turn the two thumbscrews on the bezel to the left until they spin loosely.
3. Once loose, use the two ejectors handles (located directly below the two thumbscrews) to remove the blank bezel.
4. Using the internal guide rails, slide the new module into the slot and push until it snaps firmly into place in the backplane.
5. Once in place, turn the two thumbscrews on the new module to the right until the module is completely secure in the slot.
6. Re-apply power to the ES-3810.

3.7.3 Disconnecting and Connecting Half-width Modules

CAUTION

Half-width modules should NEVER be installed in the ES-3810 unless securely connected to another half-width module (blank module or functional module). Attempting to install a half-width module by itself may result in damage to the ES-3810 backplane.

NOTE

When adding a module to the *ForeRunner* ES-3810, except in the case of an ESM-24, the individual port configurations for all ports will be returned to the factory defaults. If special port configurations have been assigned they should be noted before the module upgrade is performed.

To install or replace an NMM, first remove any terminal connections, then follow the instructions in this section. After installing the NMM, follow the instructions in Section 2.5 for information on connecting the management station.

Half-width modules for the ES-3810 come from FORE Systems already connected to either another half-width module or a blank half-width module, forming a full-width module. All half-width modules installed in an ES-3810 are connected this way.

If you order a half-width module from FORE Systems as an add-on, it comes pre-attached to a blank half-width module. You can then install this module as if it were a full-width module. If you wish to install an add-on half-width module (e.g., an NMM) in an ES-3810 slot that already contains a half-width module (e.g., an ATM uplink), you will need to perform the following procedure:

1. Remove the ATM uplink (see Section 3.7.1).
2. Disconnect the blank half-width module from the ATM uplink (see Section 3.7.3.1).
3. Disconnect the blank half-width module from the NMM (see Section 3.7.3.1).
4. Connect the NMM and the ATM uplink (NMM on the left and ATM uplink on the right, see Section 3.7.3.2).
5. Install the connected NMM and ATM uplink (see Section 3.7.2).

3.7.3.1 Disconnecting Half-width Modules

You may need to disconnect two half-width modules to replace a failed module or to utilize more slots in the ES-3810 chassis. To disconnect two half-width modules, follow the steps below.

1. If the modules being disconnected are installed in the ES-3810, see Section 3.7.1 for information about removing a full-width module. If the modules are not installed in the ES-3810, move on to Step 2.
2. On the bottom side of the module being replaced (i.e., the blank module or the failed module), remove the screws that secure the module to the connecting brace.
3. On the front of the module being replaced, turn the thumbscrew attached to the connecting brace to the left until it spins loosely.

3.7.3.2 Connecting Half-width Modules

1. Line up the replacement module with the module to which it is being connected.
2. On the front of the replacement module, turn the thumbscrew in front of the connecting brace to the right until it is tight.
3. On the bottom side of the replacement module, line up the holes in the module with those in the connecting brace and secure the screws removed in Section 3.7.3.1 to the brace.
4. Install the attached modules in the ES-3810 chassis according to the instructions in Section 3.7.2.

3.8 Power Supply Removal/Replacement

The power supplies in the ES-3810 chassis (FORE Part Number ES-3810/CH) are hot-swappable. Each supply utilizes its own power cord, allowing for separate electrical connections. With redundant power supplies installed, a single power supply failure on the ES-3810 will not cause the switch to stop functioning.

To remove or replace an ES-3810 power supply without shutting down the unit, follow the procedures in this section.

WARNING!

DO NOT attempt to add or remove a power supply that is connected to an electrical outlet. Failure to follow this warning may result in equipment damage or operator injury.

DO NOT attempt to remove/replace a power supply module without reading this section. Serious injury to the user or damage to the equipment may result if proper replacement procedures are not followed.

It is highly recommended that you use a grounding strap when handling this or any other component.

NOTE

You will need a Phillips screwdriver to perform the procedures in Section 3.8.1 and Section 3.8.2.

3.8.1 Removing a Power Supply

The procedure for removing an ES-3810 power supply is as follows:

WARNING!

Failure to perform Steps 1 and 2 can result in serious injury to the user or damage to the equipment.

1. Flip the power switch of the supply being removed to the OFF position.
2. Unplug and remove the power cord from the supply being removed (remove the power cord from both the power supply and the AC source).
3. Remove and retain the two Phillips screws near the top of the power supply or slot cover being removed.
4. Turn the two thumbscrews, on the supply or cover being removed, to the left until they spin loosely (you may need to use a Phillips screwdriver to loosen the thumbscrews).
5. Pull on the thumbscrews to unseat the power supply or slot cover and remove it from the chassis.

3.8.2 Adding or Replacing a Power Supply

The procedure for adding an ES-3810 power supply is as follows:

WARNING! Failure to perform Step 1 can result in serious injury to the user or damage to the equipment.

1. Remove the old supply or slot cover according to the instructions in Section 3.8.1.
2. Carefully align the new power supply in the empty slot and push on the center of its faceplate to slide it back into the enclosure.
3. Press firmly to seat the power supply and tighten the two thumbscrews to secure it in the chassis.
4. To ensure maximum safety and to ensure that the connectors have been seated properly, tighten the two thumbscrews using a Phillips screwdriver.
5. Insert and tighten the two Phillips screws in the holes near the top of the power supply.
6. Connect the power cord to the new supply in the ES-3810 chassis and plug the cord into an approved electrical outlet.
7. Flip the power switch on the new supply to the ON position.

3.9 Applying Power to the ES-3810

WARNING!

Ensure the following steps have been performed before applying power to the ES-3810.

1. Thoroughly read and understand Chapter 2 and Chapter 3.
2. Visually inspect the ES-3810, its packaging, and the contents of the accessory kit for damage (see Section 2.2.1).
3. Attach a management console (see Section 2.5).
4. Install all desired modules in the ES-3810 chassis (see Section 3.7).
5. Understand port characteristics and the effects of modifying them (see the *ForeRunner ES-3810 Configuration Manual*).

Once the above steps have been completed, attach the included power cord(s) to the rear of the ES-3810, plug the other end of the cord(s) into an approved electrical outlet, and turn the power switch(es) to the ON position (see Figure 3.20).

The power connection and ON/OFF switch are located on the left rear of the single-power supply ES-3810 chassis (see Figure 3.20). On the new ES-3810 chassis (ES-3810/CH), the power connection and ON/OFF switch are located on the individual power supplies (where the fan is located in the figure below).

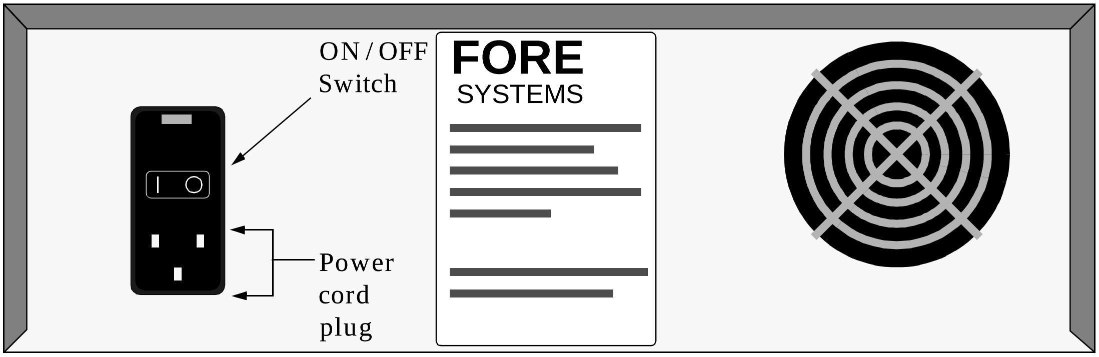


Figure 3.20 - Rear View of ES-3810

CHAPTER 4 Software Upgrade Procedures

This chapter details the procedures used to upgrade the operational software on the ES-3810. On the ES-3810, software release versions 4.13.x can be upgraded via TFTP or over the NMC's serial port. Software release versions 5.1.x can only be upgraded via TFTP, as the image is too large for serial transmission to the NMM.

4.1 TFTP Upgrades (Versions 4.13.x and 5.1.x)

This section provides information about performing a software upgrade via TFTP.

NOTE

This section assumes that the ES-3810 being upgraded has already been configured with a proper IP address and subnet mask. (See Chapter 5 of the *ForeRunner ES-3810 Configuration Manual*.)

4.1.1 Obtaining the Software Upgrade File

The software upgrade file can be obtained from FORE Systems' Technical Assistance Center (TAC). (See Page ii of the *Preface* for information about contacting TAC.)

4.1.2 Configuring the TFTP Server

After obtaining the TFTP upgrade file, place it according to the specific instructions for the TFTP server that you are using.

NOTE

The TFTP server should be on the same subnet as the ES-3810 being upgraded.

4.1.3 Performing the Upgrade

After placing the upgrade file, log on to the ES-3810 and perform the steps in the following two sections. (See Chapter 1 of the *ForeRunner ES-3810 Configuration Manual* for more information about logon procedures.)

4.1.3.1 Selecting the Software to Upgrade

1. From the Main Menu, select option 1, “Manage System.”
2. From the Manage System Menu, select option 4, “Manage Software.”
3. Ensure that `NMM System Software` is displayed in the upper right corner of the Manage Software Menu. If `NMM System Software` appears here, move on to Section 4.1.3.2. If `NMM Bootstrap Software` appears here, select option 3, “Select Another Software Module.”
4. When the Software Selection screen appears, enter the number of the option that corresponds to **`NMM System Software`**.
5. After returning to the Manage Software Menu, ensure that `NMM System Software` appears in the upper right corner of the screen and move on to Section 4.1.3.2.

4.1.3.2 Downloading the Software

1. From the Manage Software Menu, select option 4, “Download Software.”
2. Carefully read the instructions that appear on the screen. Take special care to ensure the following:
   - the operational software is successfully backed up to RAM
   - the upgrade is on a TFTP on the same subnet as the ES-3810
3. If you are ready to perform the TFTP download, type **`y`** and press `<ENTER>`, otherwise enter **`n`**.
4. When prompted, enter the IP address of the TFTP server to which the upgrade file was saved.
5. When prompted, enter the name of the upgrade file.
6. When the upgrade process begins, the `DOWNLOADING...` message appears.

If the download is successful, press `<ENTER>` when prompted and the ES-3810 will restart with the new software.

If the download fails (e.g., the upgrade file can not be found on the specified server), the current software image will be restored from RAM. Press `<ENTER>` to return to the Manage Software Menu.

4.2 Serial Port Upgrades (Version 4.13.x only)

This section provides information about performing a software upgrade via the NMC's serial port.

4.2.1 Obtaining the Software Upgrade File

The software upgrade file can be obtained from FORE Systems' Technical Assistance Center (TAC). (See Page ii of the *Preface* for information about contacting TAC.)

4.2.2 Configuring the Console Client

Once you have obtained the software upgrade file, ensure that you can access it from the management console, then set up your terminal emulation package to run at 38,400 bps.

CAUTION

You must use the XMODEM transfer protocol for the serial download.
The following applications have been known to perform unreliably at times for the purpose of the serial port download: Terminal in Windows 3.11 and NT 3.5x and HyperTerminal in Windows 95 and NT 4.0

NOTE

A serial upgrade can be performed at 9,600 bps, but it may take as long as 30 minutes.

4.2.3 Accessing the NMC Monitor

The serial port upgrade is performed from the NMC monitor (i.e., MON960). Gain access to the monitor as follows:

1. While at the management station, power-cycle the ES-3810 (i.e., turn the power to the ES-3810 off and on again).
2. As soon as power is applied, continually strike the `<ENTER>` key until the MON-960 banner appears, as shown below:

```
Mon960 User Interface: Version 4.0.2 Jun  7 1996
NMM; for i960 CA; CA stepping number 04
Copyright 1992, 1994 Intel Corporation
=>
```

4.2.4 Performing the Upgrade

To upgrade the ES-3810's NMC operational software, perform the following steps:

CAUTION

Type the following command carefully. Entering the wrong string can render the NMC inoperable.

1. Enter the following at the => prompt:

```
ef app-pri <RETURN>

do 503E8000 <RETURN>
```

These commands prepare the NMC to receive the software upgrade file.

2. Send the new software image to the NMC from your console client according to the specific procedures for that client.
3. After the download is complete, enter **`rs`** at the => prompt to restart the system.

The ES-3810 should restart using the new software image. If not, or if you have any problems with the upgrade, contact FORE Systems' Technical Assistance Center.

APPENDIX A Network Design

The ES-3810 is designed to provide private, switched Ethernet (10 Mbps or 100 Mbps) for users in small to medium-sized workgroups. The ES-3810's ATM uplink lets the workgroup extend (using LANE 1.0 and MPOA) into an ATM network where high-performance servers and routers reside.

This chapter provides information about designing a network architecture using the ES-3810, including examples of some of the more common network designs. Additionally, this chapter provides information about assigning VLAN membership, IP Multicast Filtering (alternatively called Internet Group Multicast Protocol, or IGMP), and managing the ES-3810 via IP.

A.1 VLAN Assignment

VLANs are OSI Layer 2 (Data Link) multicast domains. VLAN membership is not necessarily tied to physical proximity—other criteria may apply. The ES-3810 supports three criteria: MAC address-based assignment to a VLAN, port-based assignment to a VLAN, and IP Multicast Group-based assignment to a VLAN.

A.1.1 MAC Address-based and Port-based VLANs

MAC address-based VLAN assignment supersedes port-based VLAN assignment. In the example shown in Figure A.1, MAC address 22-22-22-22-22-22 has been assigned to VLAN "Sales," but is currently connected to a port with a port level assignment to VLAN "Default." MAC address 22-22-22-22-22-22 would only be able to broadcast to VLAN "Sales." The ES-3810 would forward broadcasts for both VLAN "Sales" and VLAN "Default" from the port.

By adding an ATM Module, you can extend any VLAN into ATM by assigning a LEC (LAN Emulation Client) instance to the VLAN. In the following example, notice that VLANs "Default," "Marketing," and "Engineering" use port-based VLAN assignment and are extended into ATM (LEC 1, 2, and 3).

The VLAN "Sales" has both port-based and MAC address-based VLAN members, but has NOT been extended into ATM (no LEC). The station with MAC address 22-22-22-22-22-22 cannot send or receive broadcasts through the ATM interface.

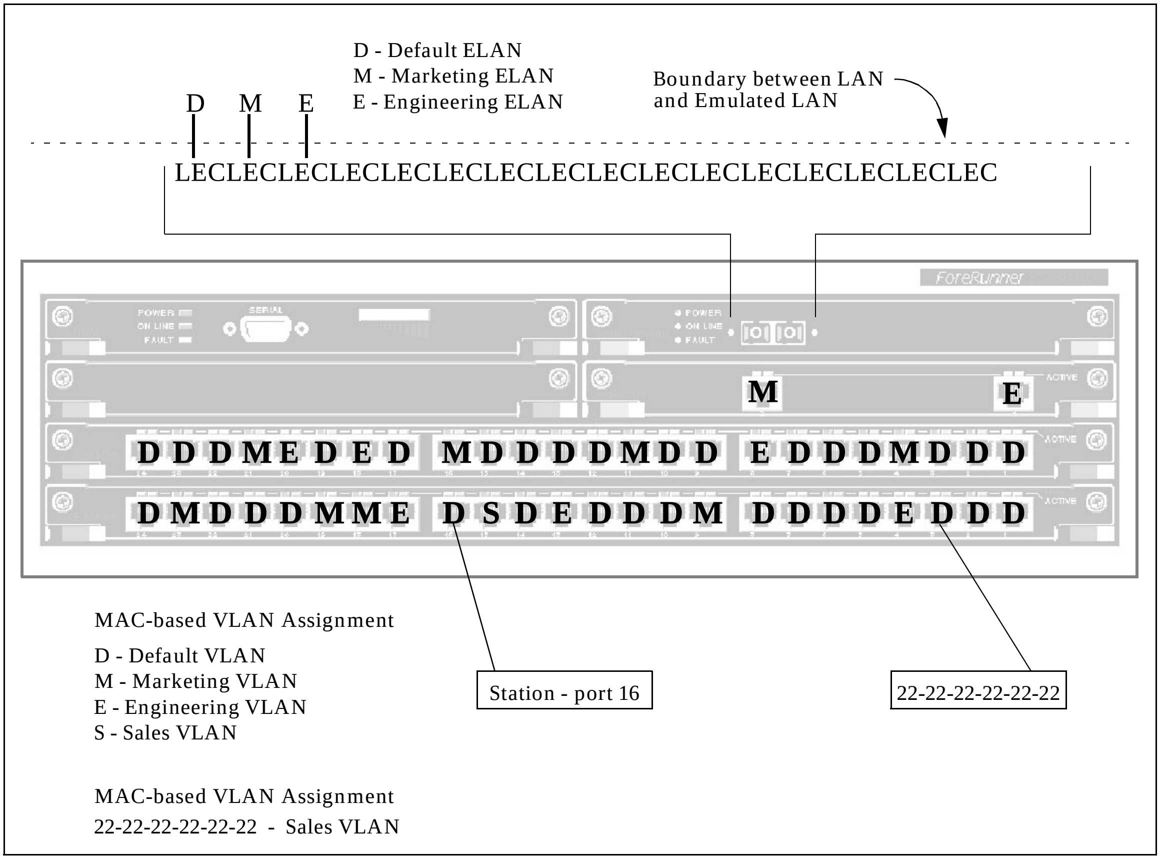

D - Default ELAN
M - Marketing ELAN
E - Engineering ELAN
Boundary between LAN and Emulated LAN
D M E
LECLECLECLECLECLECLECLECLECLECLECLECLECLECLECLEC
ForeRunner
POWER
ON LINE
FAULT
SERIAL
ACTIVE
M E
D D D M E D E D M D D D D M D D E D D D M D D D
D M D D D M M E D S D E D D D M D D D D E D D D
MAC-based VLAN Assignment
D - Default VLAN
M - Marketing VLAN
E - Engineering VLAN
S - Sales VLAN
Station - port 16
22-22-22-22-22-22
MAC-based VLAN Assignment
22-22-22-22-22-22 - Sales VLAN

Figure A.1 - MAC and Port-based VLANs

NOTE

A VLAN extended into ATM must be named with the same NAME and CASE as the ELAN. For example, an ELAN called “Engineering,” exists and you want the station on ES-3810 port 16 to join it. On the ES-3810, you must create a VLAN called “Engineering” (not “engineering”), and assign port 16 to it. When asked to “configure a LEC,” say yes. The ES-3810 will join (in proxy) the ELAN called “Engineering” and allow the station on port 16 to communicate with it.

A.1.2 IGMP-based VLANs

Some TCP/IP applications use IP multicasts to deliver data to many stations at once. However, multicasting can cause problems because stations that are not interested in receiving the multicast data see it anyway. This causes Ethernet segment congestion and unnecessary interrupts on workstations. Filtering these multicasts via IGMP can reduce this congestion and keep network traffic moving.

When creating a VLAN on the ES-3810, either by port-based or MAC address-based criteria, you are prompted to enable or disable IP Multicast Filtering (IGMP) support. If you disable this function, all IP multicasts coming into a VLAN are flooded to all ports and MAC addresses in that VLAN.

If you enable IGMP, flooding of IP multicasts is disabled. The ES-3810 snoops IP multicast frames to determine which ports and which MAC addresses are joining and leaving groups. The ES-3810 only forwards a specific IP multicast group's traffic out a specific port (or to a MAC address) that wishes to join that specific IP multicast group.

Once a station issues a multicast leave command for a specific multicast group, the ES-3810 stops forwarding multicast traffic for that group out that port. The ES-3810 can support up to 50 IP multicast groups per VLAN. See Figure A.2 for an example of how IGMP works.

NOTE

An IP address must be assigned to the NMM for IGMP to work.

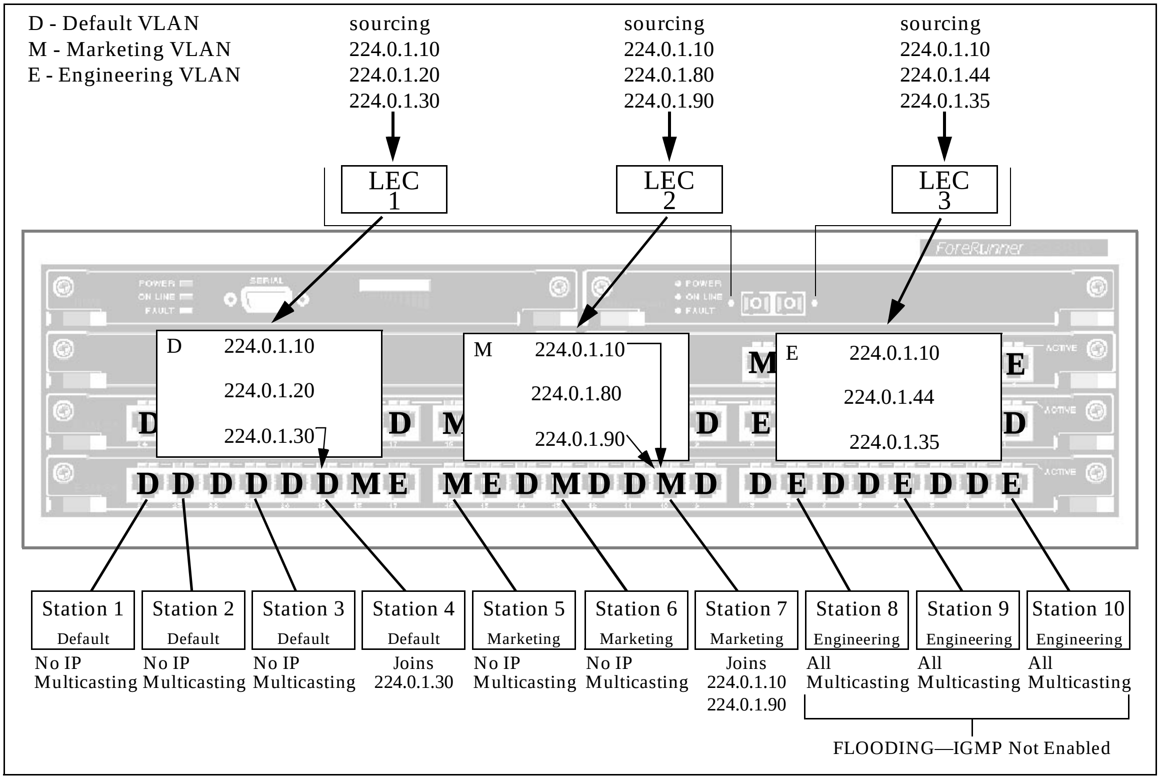


Figure A.2 - Example of IGMP

NOTE

IGMP is designed to add further granularity within a VLAN. If a station from two separate VLANS join the same IP multicast group, the IP multicast stream has to be sourced twice, once within each VLAN.

The IP client of the ES-3810 is reachable from the first configured VLAN, independent of that VLAN's name. Since, by default, the first VLAN is called "default," that is where the IP client is reachable. If the first VLAN is made to be called "Sales," and "default" is now further down in the list, the IP client would still be in "Sales," the first configured VLAN.

A.2 Network Design Alternatives

This section details several network design alternatives in which the ES-3810 can be utilized.

A.2.1 Routerless Network

A routerless network is one in which the ES-3810 switches Ethernet-attached hosts to ATM where high-speed servers are found. Typically, one or several of the following network scenarios applies:

- Network has no VLAN-to-VLAN traffic requirement
- Primary network OS is Client/Server-based
- Security is a major concern
- Servers are on ATM for maximum performance

Any network matching one or more of the above scenarios would benefit from a routerless design, because clients from different VLANs can access the same server, but not other VLANs.

This network design option is made possible because *ForeRunner* ATM adapters and LAN access devices support multiple LEC instances. Designing the network along this method (no inter-VLAN communication between clients) reduces the size of broadcast domains and reduces the need for routers on the network. See Figure A.3 for an example of this network design.

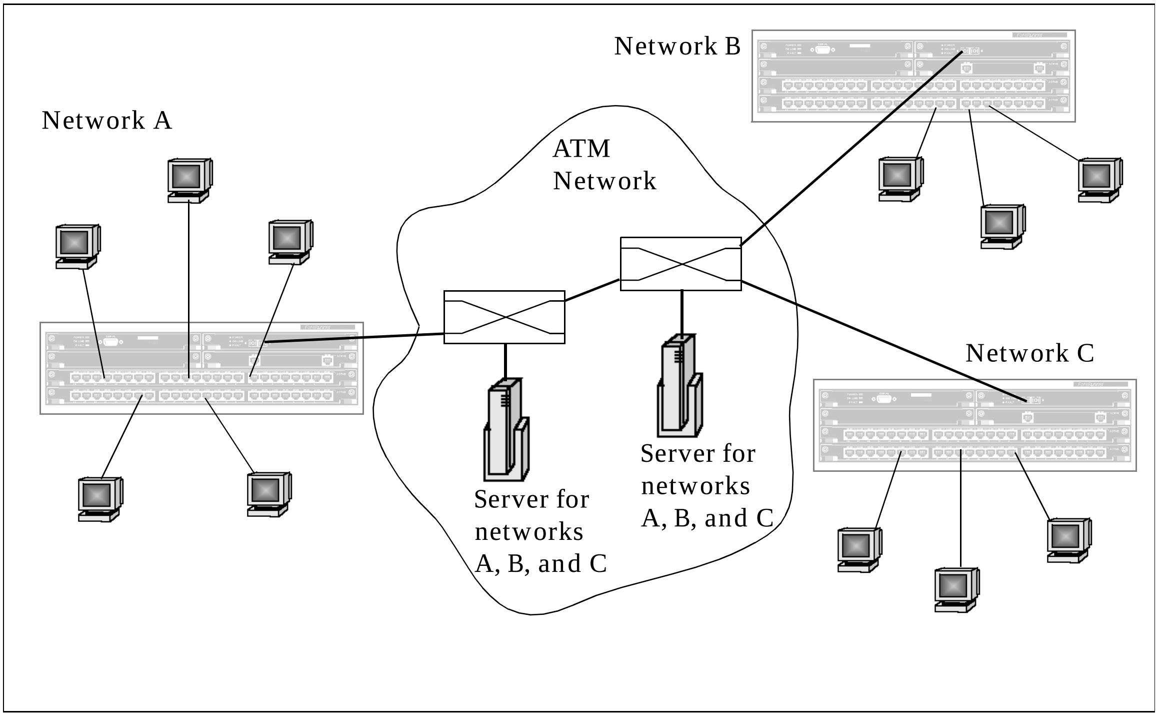


Figure A.3 - Routerless Network Design

In Figure A.3, three emulated Ethernet LANs exist (i.e., three LES/BUS pairs and 1 LECS configured in the ATM domain). Each ES-3810 joins only one (one LEC enabled) emulated LAN while each server joins all three (3 LEC instances).

A different IPX network number exists in each emulated LAN (the servers are configured with a unique network number to each LEC instance), but no router exists (i.e., communication is not possible between the different IPX networks). Broadcast domains are kept small, and all network servers can be reached via switching.

NOTE

In this example, each ES-3810 joins only one emulated LAN. Using Port and MAC address-based VLAN assignment, an ES-3810 can join up to 16 different ELANs.

A.2.2 Centralized Routing Network

A centralized routing network is one in which the ES-3810 switches Ethernet-attached hosts to ATM where high-speed servers and router interfaces are found. Typically, the ES-3810 can be utilized in a network that meets one or more of the following criteria:

- Maintenance of a relatively flat network.
- Some VLAN to VLAN communication required (bridging/routing).
- Some VLAN to VLAN packet level filtering/firewalling required.
- Traffic is 80% local, 20% routed.
- Network has grown over time by adding routers, leading to an extremely subnetted network that adds little value. This network could collapse into fewer subnets by switching to ATM.
- Desire for fastest connectivity into major ATM servers.

See Figure A.4 for an example of the a centrally routed network that uses IP.

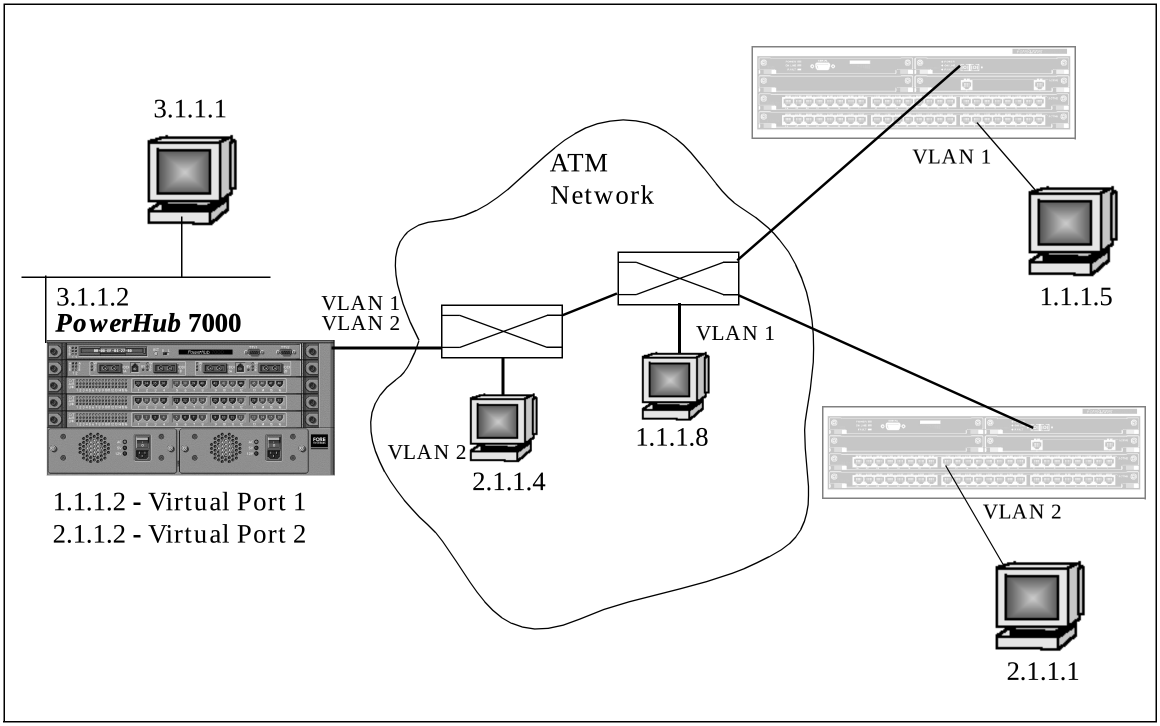


Figure A.4 - Centralized Routing Network Design

In Figure A.4, the *PowerHub* 7000 is acting as a “virtual router” between the 2.0.0.0 (VLAN 2) and 1.0.0.0 (VLAN 1) networks. This design works best when the majority of communication in the network is 80% local and 20% routed.

Low cost LAN access devices (i.e., the ES-3810) with low latency switching can be used at the edge for connecting to high-speed servers and high-speed router interfaces. In this network, two LES/BUS pairs and one LECS exist within the ATM domain. The *PowerHub* 7000 “virtual router” has two LEC instances configured—one attached to each Emulated LAN.

This model works best when the majority of LAN segments are one access device “hop” away from the ATM domain, where a low latency path to ATM servers is critical but VLAN-to-VLAN communication is also necessary. In this model, filtering and firewalling can be applied at the *PowerHub* 7000.

NOTE

These basic models—Routerless and Centralized Routing—can be combined to meet many LAN design requirements.

A.2.3 VLAN Extension over ATM

A VLAN can be extended across ATM using LANE 1.0. Many LANE instances can exist in the same ATM domain (the ES-3810 can join up to 16 concurrently). The LES/BUS services allow multiple entry points into a broadcast domain.

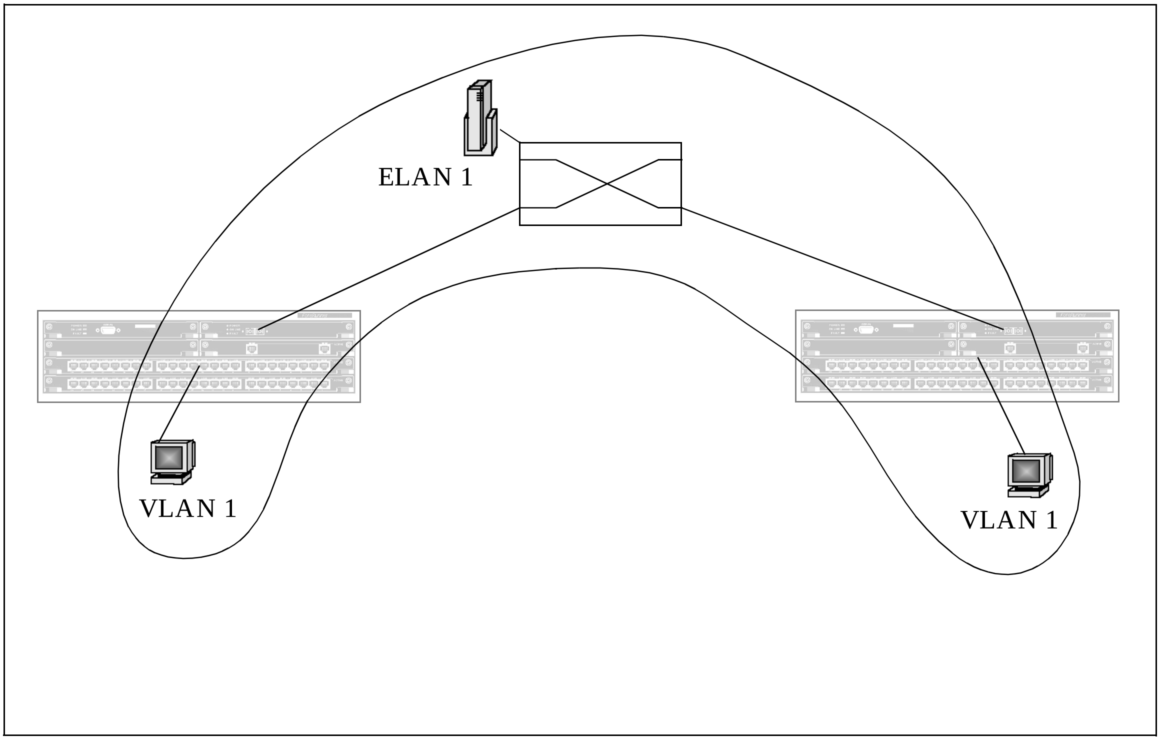


Figure A.5 - Extending a VLAN over ATM

A.2.4 VLAN Extension over Fast Ethernet

A VLAN can be extended across 100Base Ethernet using VLAN tagging. The 100Base ports on the ES-3810 support a tagging function which allows ES-3810 units to be attached to each other sequentially. Up to 16 VLANs can exist among all ES-3810 units attached in this way.

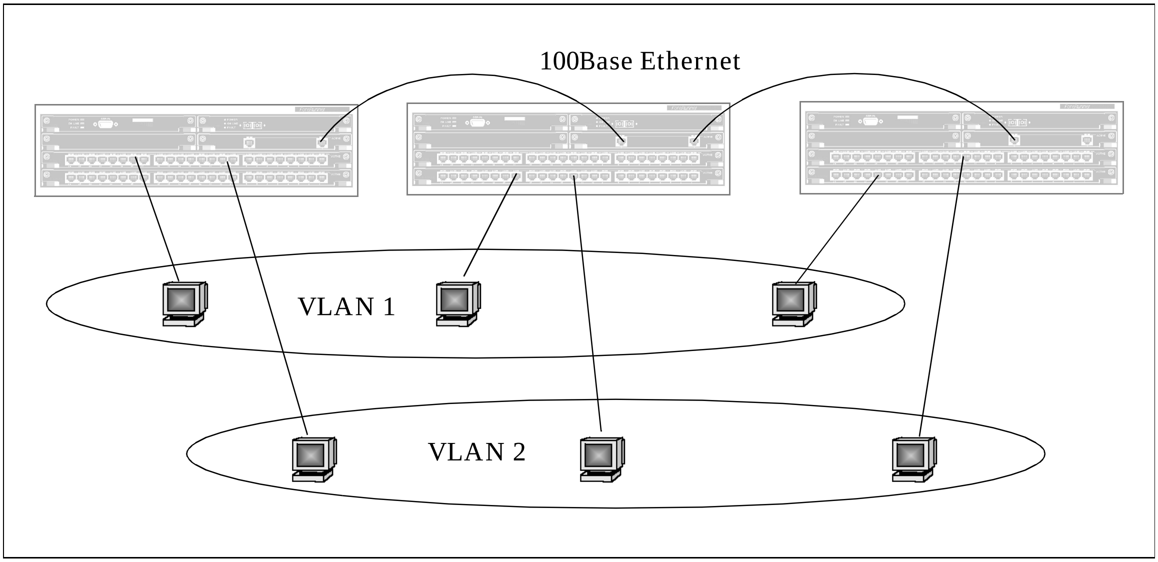


Figure A.6 - Extending a VLAN over Fast Ethernet

NOTE

In order to configure the above network, the 100Base ports must be configured for Backbone with Tagging.

NOTE

In this software release, Spanning Tree on 100Base Backbone Tagging is not supported.

CAUTION

There is an incompatibility using FEM-2/backbone with segment switch modules to the desktop. A workaround for this is to use one segment switch module for a backbone port.

A.3 Typical Configurations

The following sections detail some typical network/workgroup scenarios in which the ES-3810 can be utilized.

A.3.1 10 Mbps Ethernet Workgroup

The most basic use of the ES-3810 is to give dedicated 10 Mbps to the desktop for a high-performance workgroup of up to 72 Ethernet users (assuming in-band management), as shown in Figure A.7.

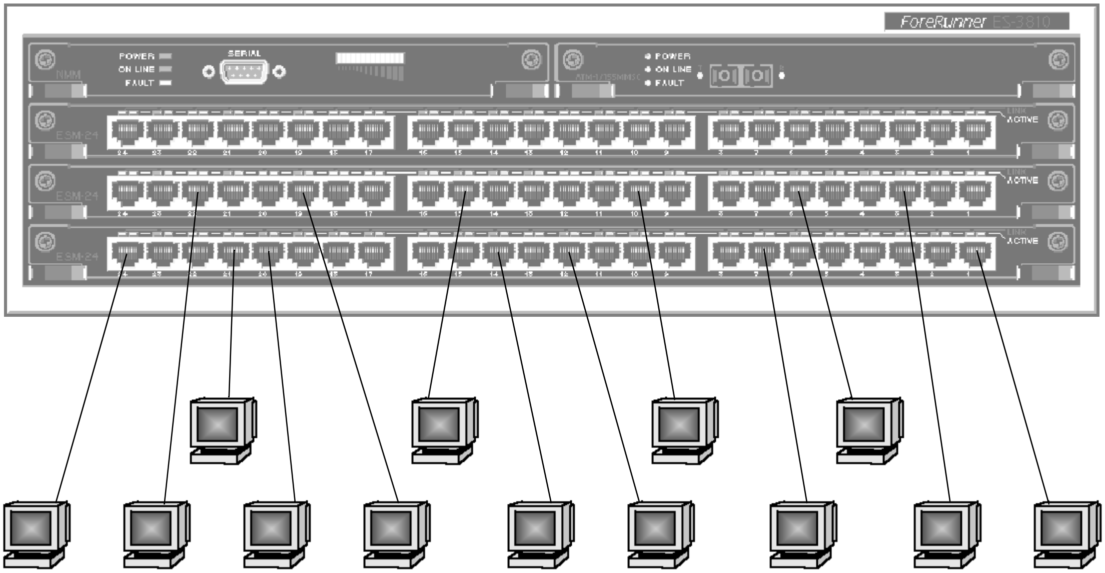


Figure A.7 - Example of a 10 Mbps Ethernet Workgroup

A.3.2 100 Mbps Ethernet Workgroup

The ES-3810 can support a high-speed workgroup of up to ten 100 Mbps stations, as shown in Figure A.8.

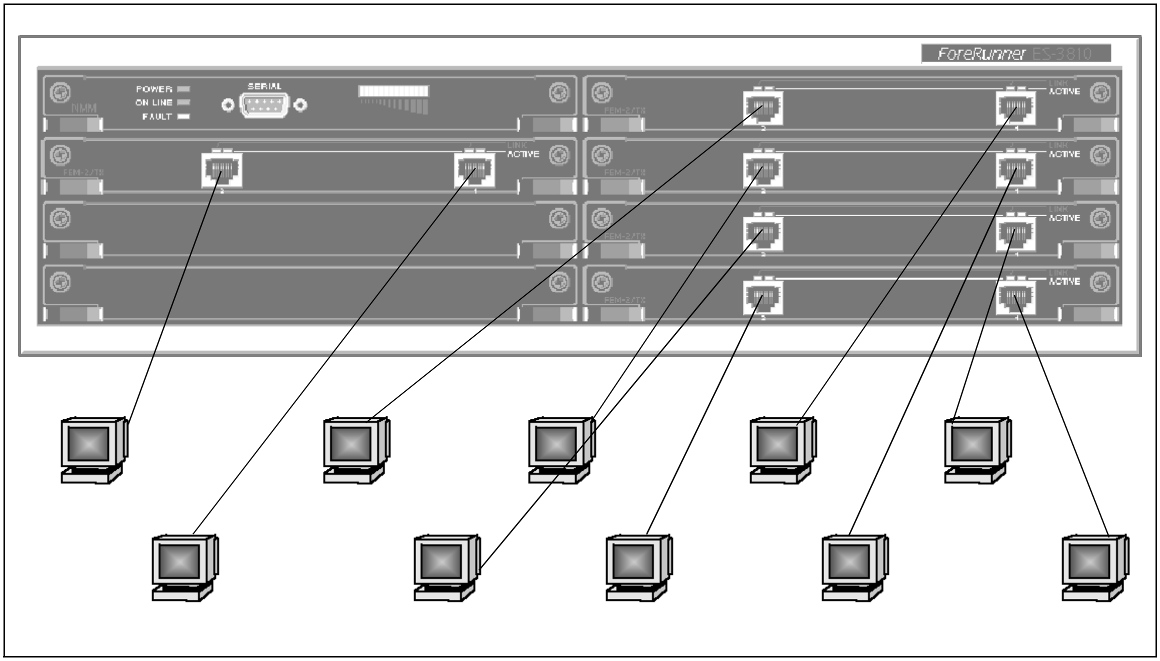


Figure A.8 - Example of a 100 Mbps Ethernet Workgroup

A.3.3 10 and 100 Mbps Ethernet Workgroup

The ES-3810 lets users combine 10 and 100 Mbps ports. This is popular for 10 Mbps to the desktop with servers on 100 Mbps Ethernet, as shown in Figure A.9.

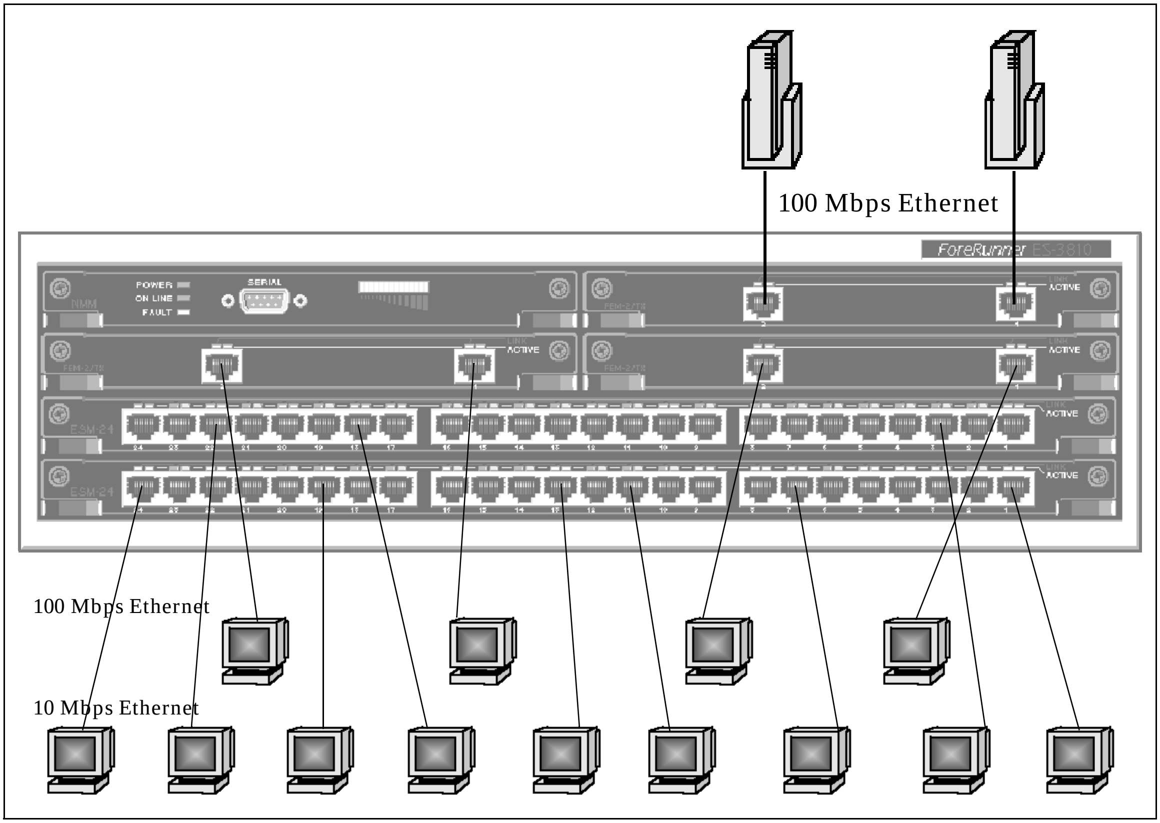


Figure A.9 - Example of a 10 Mbps and 100 Mbps Ethernet Workgroup

A.3.4 10 and 100 Mbps Ethernet Workgroup with ATM

A 10 and 100 Mbps workgroup can be linked to an ATM network. The combination of 10 Mbps to the desktop, 100 Mbps to local workgroup servers, and an ATM uplink into a LANE network in which corporate servers and router interfaces reside is an efficient and cost-effective solution.

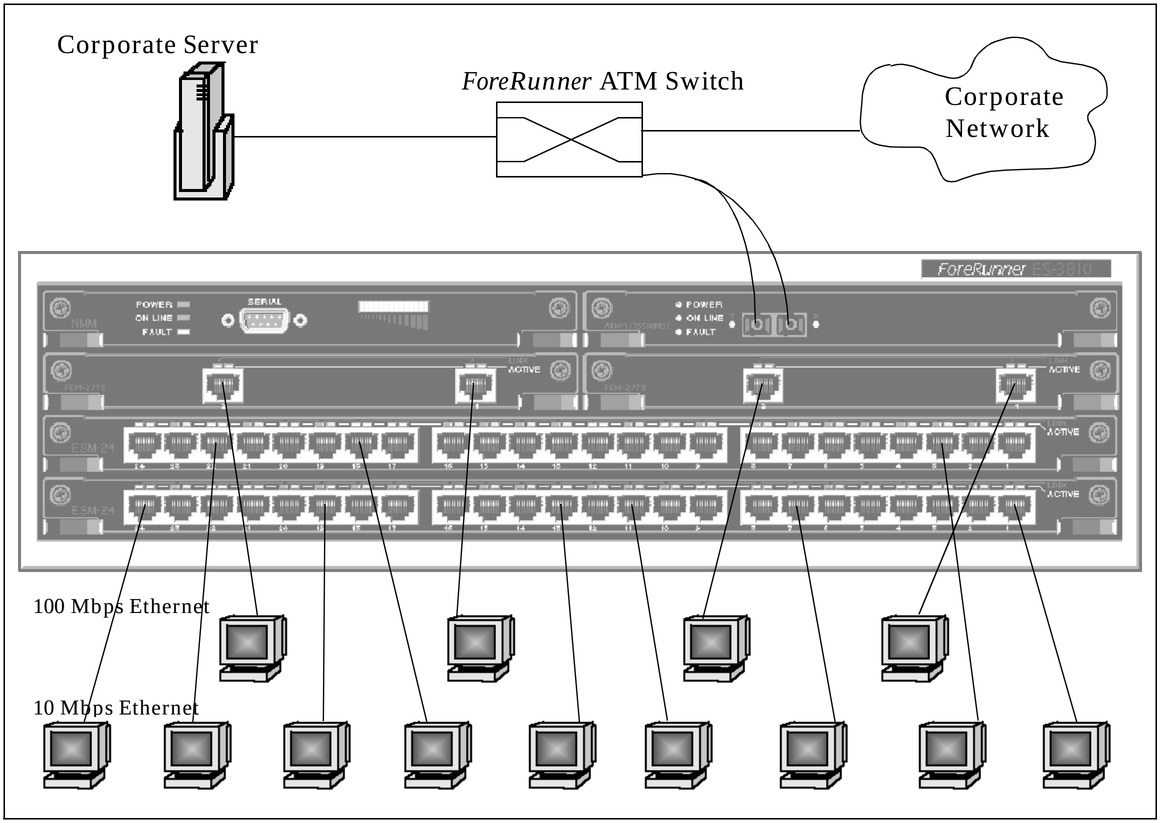


Figure A.10 - Example of a 10 Mbps and 100 Mbps Ethernet Workgroup Connected to ATM

Acronyms

The networking terms in the following list are defined in the Glossary of this manual. Glossary items are listed alphabetically according to the full term.

AAL	ATM Adaptation Layer
ABR	Available Bit Rate
ACM	Address Complete Message
ACR	Allowable Cell Rate
ADPCM	Adaptive Differential Pulse Code Modulation
AHFG	ATM-attached Host Functional Group
AIMUX	ATM Inverse Multiplexing
AIS	Alarm Indication Signal
AMI	Alternate Mark Inversion
AMI	ATM Management Interface
ANSI	American National Standards Institute
APCM	Adaptive Pulse Code Modulation
API	Application Program Interface
APP	Application Program
APS	Automatic Protection Switching
ARP	Address Resolution Protocol
ASCII	American Standard Code for Information Interchange
ATDM	Asynchronous Time Division Multiplexing
ATM	Asynchronous Transfer Mode
AUI	Attachment User Interface
B8ZS	Bipolar 8 Zero Substitution
BCOB	Broadband Connection Oriented Bearer
BCOB-A	Bearer Class A
BCOB-C	Bearer Class C
BCOB-X	Bearer Class X
BECN	Backward Explicit Congestion Notification
BER	Bit Error Rate
BES	Bursty Errored Seconds
BGP	Border Gateway Protocol
B-ICI	B-ISDN Inter-Carrier Interface.
BIP	Bit Interleaved Parity
B-ISDN	Broadband Integrated Services Digital Network
B-ISUP	Broadband ISDN User’s Part
BITS	Building Integrated Timing Supply
BNC	Bayonet-Neill-Concelman

BPDU	Bridge Protocol Data Unit
bps	Bits per Second
BPV	Bipolar Violation
B-TE	Broadband Terminal Equipment
BUS	Broadcast and Unknown Server
CAC	Connection Admission Control
CAS	Channel Associated Signaling
CBDS	Connectionless Broadband Data Service
CBR	Constant Bit Rate
CCITT	International Telephone and Telegraph Consultative Committee
CCS	Common Channel Signaling
CDV	Cell Delay Variation
CE	Connection Endpoint
CEI	Connection Endpoint Identifier
CES	Circuit Emulation Service
CGA	Carrier Group Alarm
CIP	Carrier Identification Parameter
CIR	Committed Information Rate
CLIP	Classical IP
CLP	Cell Loss Priority
CLR	Cell Loss Ratio-1-15
CLS	Connectionless service
CMIP	Common Management Interface Protocol
CMR	Cell Misinsertion Rate
CPE	Customer Premise Equipment
CRA	Cell Rate Adaptation
CRC	Cyclic Redundancy Check
CRS	Cell Relay Service
CS	Controlled Slip, **or** Convergence Sublayer
CSU	Channel Service Unit
CTD	Cell Transfer Delay
CTS	Clear To Send
DACS	Digital Access and Cross-Connect System
DARPA	Defense Advanced Research Projects Agency
DCC	Data Country Code
DCE	Data Communications Equipment
DCS	Digital Cross-connect System
DES	Destination End Station
DFA	DXI Frame Address
DLCI	Data Link Connection Identifier
DNS	Domain Naming System
DSn	Digital Standard n (n=0, 1, 1C, 2, and 3)

DSR	Data Set Ready
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
EEPROM	Electrically Erasable Programmable Read Only Memory
EFCI	Explicit Forward Congestion Indication
EGP	Exterior Gateway Protocol
EIA	Electronics Industries Association
EISA	Extended Industry Standard Architecture
ELAN	Emulated Local Area Network
EMI	Electromagnetic Interference
EPROM	Erasable Programmable Read Only Memory
EQL	Equalization
ER	Explicit Rate
ES	End System, **or** Errored Second
ESF	Extended Super Frame
ESI	End System Identifier
EXZ	Excessive Zeroes (Error Event)
FC	Face Contact
FCC	Federal Communications Commission
FCS	Frame Check Sequence
FDDI	Fiber Distributed Data Interface
FDM	Frequency Division Multiplexing
FEBE	Far End Block Error
FEC	Forward Error Correction
FECN	Forward Explicit Congestion Notification
FERF	Far End Receive Failure
FIFO	First-In, First-Out
FRS	Frame-Relay Service
FTP	File Transfer Protocol
FT-PNNI	ForeThought PNNI
FUNI	Frame-Based UNI
GCAC	Generic Connection Admission Control
GCRA	Generic Cell Rate Algorithm
GFC	Generic Flow Control
HDB3	High Density Bipolar
HDLC	High Level Data Link Control
HEC	Header Error Control
HIPPI	High Performance Parallel Interface
HSSI	High-Speed Serial Interface
ICMP	Internet Control Message Protocol
IDU	Interface Data Unit
IEEE	Institute of Electrical and Electronics Engineers

IETF	Internet Engineering Task Force
ILMI	Interim Local Management Interface
IP	Internet Protocol
IPX	Internetwork Packet Exchange
IS	Intermediate system
ISDN	Integrated Services Digital Network
ISO	International Standards Organization
ITU-T	International Telecommunication Union Telecommunication
IWF	Interworking Function
IXC	Interexchange Carriers
JPEG	Joint Photographic Experts Group
Kbps	Kilobits per second
LAN	Local Area Network
LANE	LAN Emulation
LAPB	Link Access Procedure, Balanced
LATA	Local Access and Transport Area
LBO	Line Build Out
LCV	Line Code Violations
LE_ARP	LAN Emulation Address Resolution Protocol
LEC	LAN Emulation Client
LECS	LAN Emulation Configuration Server
LES	LAN Emulation Server
LLC	Logical Link Control
LOF	Loss Of Frame
LOP	Loss Of Pointer
LOS	Loss Of Signal
LSB	Least Significant Bit
MAC	Media Access Control
MAN	Metropolitan Area Network
MAU	Media Attachment Unit
MBS	Maximum Burst Size
MCDV	Maximum Cell Delay Variance
MCLR	Maximum Cell Loss Ratio
MCR	Minimum Cell Rate
MCTD	Maximum Cell Transfer Delay
MIB	Management Information Base
MIC	Media Interface Connector
MID	Message Identifier
MMF	Multimode Fiber Optic Cable
MPEG	Motion Picture Experts Group
MPOA	Multiprotocol over ATM
MSB	Most Significant Bit
MTU	Maximum Transmission Unit

NM	Network Management Entity
NML	Network Management Layer
NMS	Network Management Station
NNI	Network-to-Network Interface or Network Node Interface
NPC	Network Parameter Control
NRZ	Non Return to Zero
NRZI	Non Return to Zero Inverted
NSAP	Network Service Access Point
NTSC	National TV Standards Committee
OAM	Operation and Maintenance Cell
OC-n	Optical Carrier level-n
OID	Object Identifier
OOF	Out-of-Frame
OSI	Open Systems Interconnection
OSPF	Open Shortest Path First Protocol
OUI	Organizationally Unique Identifier
PAD	Packet Assembler Disassembler
PAL	Phase Alternate Line
PBX	Private Branch Exchange
PCI	Peripheral Component Interconnect
PCM	Pulse Code Modulation
PCR	Peak Cell Rate
PDN	Public Data Network
PDU	Protocol Data Unit
PHY	Physical Layer
ping	Packet Internet Groper
PLCP	Physical Layer Convergence Protocol
PLP	Packet Level Protocol
PM	Physical Medium
PMD	Physical Medium Dependent
PNNI	Private Network Node Interface or Private Network-to-Network Interface
PPP	Point-to-Point Protocol
PROM	Programmable Read-Only Memory
PRS	Primary Reference Source
PSN	Packet Switched Network
PT	Payload Type
PVC	Permanent Virtual Circuit (or Channel)
PVCC	Permanent Virtual Channel Connection
PVPC	Permanent Virtual Path Connection
QD	Queuing Delay
QoS	Quality of Service
RD	Routing Domain
RFCs	Requests For Comment

RFI	Radio Frequency Interference
RIP	Routing Information Protocol
RISC	Reduced Instruction Set Computer
RTS	Request To Send
SA	Source Address
SA	Source MAC Address
SAP	Service Access Point
SAR	Segmentation And Reassembly
SC	Structured Cabling, **or** Structured Connectors, **or** Stick and Click
SCR	Sustainable Cell Rate
SCSI	Small Computer Systems Interface
SDLC	Synchronous Data Link Control
SDU	Service Data Unit
SEAL	Simple and Efficient Adaptation Layer
SECAM	Systeme En Coleur Avec Memoire
SEL	Selector
SES	Severely Errored Seconds
SF	Super Frame
SGMP	Simple Gateway Management Protocol
SIR	Sustained Information Rate
SLIP	Serial Line IP
SMDS	Switched Multimegabit Data Service
SMF	Single Mode Fiber
SMTP	Simple Mail Transfer Protocol
SNA	Systems Network Architecture
SNAP	SubNetwork Access Protocol
SNI	Subscriber Network Interface
SNMP	Simple Network Management Protocol
SONET	Synchronous Optical Network
SPANS	Simple Protocol for ATM Network Signalling
SPARC	Scalable Processor Architecture Reduced instruction set Computer
SPE	Synchronous Payload Envelope
SPVC	Smart PVC
SS7	Signaling System No. 7
SSCOP	Service Specific Connection Oriented Protocol
SSCS	Service Specific Convergence Sublayer
ST	Straight Tip, **or** Stick and Turn
STM	Synchronous Transfer Mode
STP	Shielded Twisted Pair, Spanning Tree Protocol
STS	Synchronous Transport Signal

SVC	Switched Virtual Circuit (or Channel)
SVCC	Switched Virtual Channel Connection
SVPC	Switched Virtual Path Connection
TAXI	Transparent Asynchronous Transmitter / Receiver Interface
TC	Transmission Convergence
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol / Internet Protocol
TCR	Tagged Cell Rate
TCS	Transmission Convergence Sublayer
TDM	Time Division Multiplexing
TE	Terminal Equipment
TFTP	Trivial File Transfer Protocol
TM	Traffic Management
UAS	Unavailable Seconds
UBR	Unspecified Bit Rate
UDP	User Datagram Protocol
UNI	User-to-Network Interface
UPC	Usage Parameter Control
UTOPIA	Universal Test & Operations Interface for ATM
UTP	Unshielded Twisted Pair
VBR	Variable Bit Rate
VC	Virtual Channel (or Circuit)
VCC	Virtual Channel Connection
VCI	Virtual Channel Identifier
VCL	Virtual Channel Link
VINES	Virtual Network Software
VLAN	Virtual Local Area Network
VP	Virtual Path
VPC	Virtual Path Connection
VPDN	Virtual Private Data Network
VPI	Virtual Path Identifier
VPL	Virtual Path Link
VPN	Virtual Private Network
VPT	Virtual Path Terminator
VS/VD	Virtual Source / Virtual Destination
VT	Virtual Tributary
WAN	Wide-Area Network
ZBTSI	Zero Byte Time Slot Interchange

Glossary

10Base-T - a 10 Mbps baseband Ethernet specification utilizing twisted-pair cabling (Category 3, 4, or 5). 10BaseT, which is part of the IEEE 802.3 specification, has a distance limit of approximately 100 meters per segment.

802.1d Spanning Tree Bridging - the IEEE standard for bridging; a MAC layer standard for transparently connecting two or more LANs (often called subnetworks) that are running the same protocols and cabling. This arrangement creates an extended network, in which any two workstations on the linked LANs can share data.

802.3 Ethernet - the IEEE standard for Ethernet; a physical-layer standard that uses the CSMA / CD access method on a bus-topology LAN.

802.5 Token Ring - the IEEE physical-layer standard that uses the token-passing access method on a ring-topology LAN.

AAL Connection - an association established by the AAL between two or more next higher layer entities.

Adapter - A fitting that supplies a passage between two sets of equipment when they cannot be directly interconnected.

Adaptive Differential Pulse Code Modulation (ADPCM) - A technique that allows analog voice signals to be carried on a 32K bps digital channel. Sampling is done at 8Hz with 4 bits used to describe the difference between adjacent samples.

Adaptive Pulse Code Modulation (APCM) - A technique that effectively reduces occupied bandwidth per active speaker by reducing sampling rates during periods of overflow peak traffic.

Address - A unique identity of each network station on a LAN or WAN.

Address Complete Message (ACM) - A B-ISUP call control message from the receiving exchange to sending exchange indicating the completion of address information.

Address Mask - a bit mask used to identify which bits in an address (usually an IP address) are network significant, subnet significant, and host significant portions of the complete address. This mask is also known as the subnet mask because the subnetwork portion of the address can be determined by comparing the binary version of the mask to an IP address in that subnet. The mask holds the same number of bits as the protocol address it references.

Address Prefix - A string of 0 or more bits up to a maximum of 152 bits that is the lead portion of one or more ATM addresses.

Address Resolution - The procedure by which a client associates a LAN destination with the ATM address of another client or the BUS.

Address Resolution Protocol (ARP) - a method used to resolve higher level protocol addressing (such as IP) into the appropriate header data required for ATM; i.e., port, VPI, and VCI; also defines the AAL type to be used.

Agent - a component of network- and desktop-management software, such as SNMP, that gathers information from MIBs.

alarm - an unsolicited message from a device, typically indicating a problem with the system that requires attention.

Alarm Indication Signal (AIS) - In T1, an all ones condition used to alert a receiver that its incoming signal (or frame) has been lost. The loss of signal or frame is detected at the receiving end, and the failed signal is replaced by all the ones condition which the receiver interprets as an AIS. The normal response to this is AIS is for the receiving end to generate a yellow alarm signal as part of its transmission towards the faulty end. (The AIS itself is sometimes called a Blue Signal).

A-Law - The PCM coding and companding standard used in Europe.

Allowable Cell Rate (ACR) - parameter defined by the ATM Forum for ATM traffic management. ACR varies between the MCR and the PCR, and is dynamically controlled using congestion control mechanisms.

Alternate Mark Inversion (AMI) - A line coding format used on T1 facilities that transmits ones by alternate positive and negative pulses.

Alternate Routing - A mechanism that supports the use of a new path after an attempt to set up a connection along a previously selected path fails.

American National Standards Institute (ANSI) - a private organization that coordinates the setting and approval of some U.S. standards. It also represents the United States to the International Standards Organization.

American Standard Code for Information Interchange (ASCII) - a standard character set that (typically) assigns a 7-bit sequence to each letter, number, and selected control characters.

AppleTalk - a networking protocol developed by Apple Computer for communication between Apple's products and other computers. Independent of the network layer, AppleTalk runs on LocalTalk, EtherTalk and TokenTalk.

Application Layer - Layer seven of the ISO reference model; provides the end-user interface.

Application Program (APP) - a complete, self-contained program that performs a specific function directly for the user.

Application Program Interface (API) - a language format that defines how a program can be made to interact with another program, service, or other software; it allows users to develop custom interfaces with FORE products.

Assigned Cell - a cell that provides a service to an upper layer entity or ATM Layer Management entity (ATMM-entity).

asxmon - a FORE program that repeatedly displays the state of the switch and its active ports.

Asynchronous Time Division Multiplexing (ATDM) - a multiplexing technique in which a transmission capability is organized into a priori, unassigned time slots. The time slots are assigned to cells upon request of each application's instantaneous real need.

Asynchronous Transfer Mode (ATM) - a transfer mode in which the information is organized into cells. It is asynchronous in the sense that the recurrence of cells containing information from an individual user is not necessarily periodic.

ATM Adaptation Layer (AAL) - the AAL divides user information into segments suitable for packaging into a series of ATM cells. AAL layer types are used as follows:

> **AAL-1 -** constant bit rate, time-dependent traffic such as voice and video
>
> **AAL-2 -** still undefined; a placeholder for variable bit rate video transmission
>
> **AAL-3/4 -** variable bit rate, delay-tolerant data traffic requiring some sequencing and/or error detection support (originally two AAL types, connection-oriented and connectionless, which have been combined)
>
> **AAL-5 -** variable bit rate, delay-tolerant, connection-oriented data traffic requiring minimal sequencing or error detection support

ATM Address - Defined in the UNI Specification as 3 formats, each having 20 bytes in length.

ATM Forum - an international non-profit organization formed with the objective of accelerating the use of ATM products and services through a rapid convergence of interoperability specifications. In addition, the Forum promotes industry cooperation and awareness.

ATM Inverse Multiplexing (AIMUX) - A device that allows multiple T1 or E1 communications facilities to be combined into a single broadband facility for the transmission of ATM cells.

ATM Layer link - a section of an ATM Layer connection between two adjacent active ATM Layer entities (ATM-entities).

ATM Link - a virtual path link (VPL) or a virtual channel link (VCL).

ATM Management Interface (AMI) - the user interface to FORE Systems' *ForeThought* switch control software (SCS). AMI lets users monitor and change various operating configurations of FORE Systems switches and network module hardware and software, IP connectivity, and SNMP network management.

ATM Peer-to-Peer Connection - a virtual channel connection (VCC) or a virtual path connection (VPC) directly established, such as workstation-to-workstation. This setup is not commonly used in networks.

ATM Traffic Descriptor - a generic list of parameters that can be used to capture the intrinsic traffic characteristics of a requested ATM connection.

ATM User-to-User Connection - an association established by the ATM Layer to support communication between two or more ATM service users (i.e., between two or more next higher layer entities or between two or more ATM entities). The communication over an ATM Layer connection may be either bidirectional or unidirectional. The same Virtual Channel Identifier (VCI) is used for both directions of a connection at an interface.

atmarp - a FORE program that shows and manipulates ATM ARP entries maintained by the given device driver. This is also used to establish PVC connections.

ATM-attached Host Functional Group (AHFG) - The group of functions performed by an ATM-attached host that is participating in the MPOA service.

atmconfig - a FORE program used to enable or disable SPANS signaling.

atmstat - a FORE program that shows statistics gathered about a given adapter card by the device driver. These statistics include ATM layer and ATM adaptation layer cell and error counts. This can also be used to query other hosts via SNMP.

Attachment User Interface (AUI) - IEEE 802.3 interface between a media attachment unit (MAU) and a network interface card (NIC). The term AUI can also refer to the rear panel port to which an AUI cable might attach.

Auto-logout - a feature that automatically logs out a user if there has been no user interface activity for a specified length of time.

Automatic Protection Switching (APS) - Equipment installed in communications systems to detect circuit failures and automatically switch to redundant, standby equipment.

Available Bit Rate (ABR) - a type of traffic for which the ATM network attempts to meet that traffic's bandwidth requirements. It does not guarantee a specific amount of bandwidth and the end station must retransmit any information that did not reach the far end.

Backbone - the main connectivity device of a distributed system. All systems that have connectivity to the backbone connect to each other, but systems can set up private arrangements with each other to bypass the backbone to improve cost, performance, or security.

Backplane - High-speed communications line to which individual components are connected.

Backward Explicit Congestion Notification (BECN) - A Resource Management cell type generated by the network or the destination, indicating congestion or approaching congestion for traffic flowing in the direction opposite that of the BECN cell.

Bandwidth - usually identifies the capacity or amount of data that can be sent through a given circuit; may be user-specified in a PVC.

Baud - unit of signalling speed, equal to the number of discrete conditions or signal events per second. If each signal event represents only one bit, the baud rate is the same as bps; if each signal event represents more than one bit (such as a dibit), the baud rate is smaller than bps.

Bayonet-Neill-Concelman (BNC) - a bayonet-locking connector used to terminate coaxial cables. BNC is also referred to as Bayonet Network Connector.

Bipolar 8 Zero Substitution (B8ZS) - a technique used to satisfy the ones density requirements of digital T-carrier facilities in the public network while allowing 64 Kbps clear channel data. Strings of eight consecutive zeroes are replaced by an eight-bit code representing two intentional bipolar pulse code violations (000V10V1).

Bipolar Violation (BPV) - an error event on a line in which the normal pattern of alternating high (one) and low (zero) signals is disrupted. A bipolar violation is noted when two high signals occur without an intervening low signal, or vice versa.

B-ISDN Inter-Carrier Interface (B-ICI) - An ATM Forum defined specification for the interface between public ATM networks to support user services across multiple public carriers.

Bit Error Rate (BER) - A measure of transmission quality, generally shown as a negative exponent, (e.g., 10^{-7} which means 1 out of 10^{7} bits [1 out of 10,000,000 bits] are in error).

Bit Interleaved Parity (BIP) - an error-detection technique in which character bit patterns are forced into parity, so that the total number of one bits is always odd or always even. This is accomplished by the addition of a one or zero bit to each byte, as the byte is transmitted; at the other end of the transmission, the receiving device verifies the parity (odd or even) and the accuracy of the transmission.

Bit Robbing - The use of the least significant bit per channel in every sixth frame for signaling.

Bit Stuffing - A process in bit-oriented protocols where a zero is inserted into a string of ones by the sender to prevent the receiver from interpreting valid user data (the string of ones) as control characters (a Flag character for instance).

Border Gateway Protocol (BGP) - used by gateways in an internet connecting autonomous networks. It is derived from experiences learned using the EGP.

bps - bits per second

Bridge - a device that expands a Local Area Network by forwarding frames between data link layers associated with two separate cables, usually carrying a common protocol. Bridges can usually be made to filter certain packets (to forward only certain traffic).

Bridge Protocol Data Unit (BPDU) - A message type used by bridges to exchange management and control information.

Broadband - a service or system requiring transmission channels capable of supporting rates greater than the Integrated Services Digital Network (ISDN) primary rate.

Broadband Access - an ISDN access capable of supporting one or more broadband services.

Broadband Connection Oriented Bearer (BCOB) - Information in the SETUP message that indicates the type of service requested by the calling user.

BCOB-A (Bearer Class A) - Indicated by ATM end user in SETUP message for connection-oriented, constant bit rate service. The network may perform internetworking based on AAL information element (IE).

BCOB-C (Bearer Class C) - Indicated by ATM end user in SETUP message for connection-oriented, variable bit rate service. The network may perform internetworking based on AAL information element (IE).

BCOB-X (Bearer Class X) - Indicated by ATM end user in SETUP message for ATM transport service where AAL, traffic type and timing requirements are transparent to the network.

Broadband Integrated Services Digital Network (B-ISDN) - a common digital network suitable for voice, video, and high-speed data services running at rates beginning at 155 Mbps.

Broadband ISDN User's Part (B-ISUP) - A protocol used to establish, maintain and release broadband switched network connections across an SS7/ATM network.

Broadband Terminal Equipment (B-TE) - An equipment category for B-ISDN which includes terminal adapters and terminals.

Broadcast - Data transmission to all addresses or functions.

Broadcast and Unknown Server (BUS) - in an emulated LAN, the BUS is responsible for accepting broadcast, multicast, and unknown unicast packets from the LECs to the broadcast MAC address (FFFFFFFFFFFF) via dedicated point-to-point connections, and forwarding the packets to all of the members of the ELAN using a single point-to-multipoint connection.

Brouter (bridging/router) - a device that routes some protocols and bridges others based on configuration information.

Buffer - A data storage medium used to compensate of a difference in rate of data flow or time of occurrence of events when transmitting data from one device to another.

Building Integrated Timing Supply (BITS) - a master timing supply for an entire building, which is a master clock and its ancillary equipment. The BITS supplies DS1 and/or composite clock timing references for synchronization to all other clocks and timing sources in that building.

Bursty Errored Seconds (BES) - a BES contains more than 1 and fewer than 320 path coding violation error events, and no severely errored frame or AIS defects. Controlled slips are not included in determining BESs.

Bursty Second - a second during which there were at least the set number of BES threshold event errors but fewer than the set number of SES threshold event errors.

Byte - A computer-readable group of bits (normally 8 bits in length).

Call - an association between two or more users or between a user and a network entity that is established by the use of network capabilities. This association may have zero or more connections.

Carrier - a company, such as any of the "baby Bell" companies, that provide network communications services, either within a local area or between local areas.

Carrier Group Alarm (CGA) - A service alarm generated by a channel bank when an out-of-frame (OOF) condition exists for some predetermined length of time (generally 300 milliseconds to 2.5 seconds). The alarm causes the calls using a trunk to be dropped and trunk conditioning to be applied.

Carrier Identification Parameter (CIP) - A 3 or 4 digit code in the initial address message identifying the carrier to be used for the connection.

cchan - a FORE program that manages virtual channels on a *ForeRunner* switch running `asxd`.

Cell - an ATM Layer protocol data unit (PDU). The basic unit of information transported in ATM technology, each 53-byte cell contains a 5-byte header and a 48-byte payload.

Cell Delay Variation (CDV) - a quantification of cell clumping for a connection. The cell clumping CDV (yk) is defined as the difference between a cell's expected reference arrival time (ck) and its actual arrival time (ak). The expected reference arrival time (ck) of cell k of a specific connection is max. T is the reciprocal of the negotiated peak cell rate.

Cell Delineation - the protocol for recognizing the beginning and end of ATM cells within the raw serial bit stream.

Cell Header - ATM Layer protocol control information.

Cell Loss Priority (CLP) - the last bit of byte four in an ATM cell header; indicates the eligibility of the cell for discard by the network under congested conditions. If the bit is set to 1, the cell may be discarded by the network depending on traffic conditions.

Cell Loss Ratio - In a network, cell loss ratio is (1-x/y), where y is the number of cells that arrive in an interval at an ingress of the network; and x is the number of these y cells that leave at the egress of the network element.

Cell Loss Ratio (CLR) - CLR is a negotiated QoS parameter and acceptable values are network specific. The objective is to minimize CLR provided the end-system adapts the traffic to the changing ATM layer transfer characteristics. The Cell Loss Ratio is defined for a connection as: Lost Cells/Total Transmitted Cells. The CLR parameter is the value of CLR that the network agrees to offer as an objective over the lifetime of the connection. It is expressed as an order of magnitude, having a range of 10-1 to 10-15 and unspecified.

Cell Misinsertion Rate (CMR) - the ratio of cells received at an endpoint that were not originally transmitted by the source end in relation to the total number of cells properly transmitted.

Cell Rate Adaptation (CRA) - a function performed by a protocol module in which empty cells (known as unassigned cells) are added to the output stream. This is because there always must be a fixed number of cells in the output direction; when there are not enough cells to transmit, unassigned cells are added to the output data stream.

Cell Relay Service (CRS) - a carrier service which supports the receipt and transmission of ATM cells between end users in compliance with ATM standards and implementation specifications.

Cell Transfer Delay - the transit delay of an ATM cell successfully passed between two designated boundaries. See CTD.

Cell Transfer Delay (CTD) - This is defined as the elapsed time between a cell exit event at the measurement point 1 (e.g., at the source UNI) and the corresponding cell entry event at the measurement point 2 (e.g., the destination UNI) for a particular connection. The cell transfer delay between two measurement points is the sum of the total inter-ATM node transmission delay and the total ATM node processing delay.

Channel - A path or circuit along which information flows.

Channel Associated Signaling (CAS) - a form of circuit state signaling in which the circuit state is indicated by one or more bits of signaling status sent repetitively and associated with that specific circuit.

Channel Bank - A device that multiplexes many slow speed voice or data conversations onto high speed link and controls the flow.

Channel Service Unit (CSU) - An interface for digital leased lines which performs loopback testing and line conditioning.

Channelization - capability of transmitting independent signals together over a cable while still maintaining their separate identity for later separation.

Circuit - A communications link between points.

Circuit Emulation Service (CES) - The ATM Forum circuit emulation service interoperability specification specifies interoperability agreements for supporting Constant Bit Rate (CBR) traffic over ATM networks that comply with the other ATM Forum interoperability agreements. Specifically, this specification supports emulation of existing TDM circuits over ATM networks.

Classical IP (CLIP) - IP over ATM which conforms to RFC 1577.

Clear to Send (CTS) - and RS-232 modem interface control signal (sent from the modem to the DTE on pin 5) which indicates that the attached DTE may begin transmitting; issuance in response to the DTE’s RTS.

Clocking - Regularly timed impulses.

Closed User Group - A subgroup of network users that can be its own entity; any member of the subgroup can only communicate with other members of that subgroup.

Coaxial Cable - Coax is a type of electrical communications medium used in the LAN environment. This cable consists of an outer conductor concentric to an inner conductor, separated from each other by insulating material, and covered by some protective outer material. This medium offers large bandwidth, supporting high data rates with high immunity to electrical interference and a low incidence of errors. Coax is subject to distance limitations and is relatively expensive and difficult to install.

Cold Start Trap - an SNMP trap which is sent after a power-cycle (see *trap*).

Collision - Overlapping transmissions that occur when two or more nodes on a LAN attempt to transmit at or about the same time.

Committed Information Rate (CIR) - CIR is the information transfer rate which a network offering Frame Relay Services (FRS) is committed to transfer under normal conditions. The rate is averaged over a minimum increment of time.

Common Channel Signaling (CCS) - A form signaling in which a group of circuits share a signaling channel. Refer to SS7.

Common Management Interface Protocol (CMIP) - An ITU-TSS standard for the message formats and procedures used to exchange management information in order to operate, administer maintain and provision a network.

Concatenation - The connection of transmission channels similar to a chain.

Concentrator - a communications device that offers the ability to concentrate many lower-speed channels into and out of one or more high-speed channels.

Configuration - The phase in which the LE Client discovers the LE Service.

Congestion Management - traffic management feature that helps ensure reasonable service for VBR connections in an ATM network, based on a priority, sustained cell rate (SCR), and peak cell rate (PCR). During times of congestion, bandwidth is reduced to the SCR, based on the priority of the connection.

Connection - the concatenation of ATM Layer links in order to provide an end-to-end information transfer capability to access points.

Connection Admission Control (CAC) - the procedure used to decide if a request for an ATM connection can be accepted based on the attributes of both the requested connection and the existing connections.

Connection Endpoint (CE) - a terminator at one end of a layer connection within a SAP.

Connection Endpoint Identifier (CEI) - an identifier of a CE that can be used to identify the connection at a SAP.

Connectionless Broadband Data Service (CBDS) - A connectionless service similar to Bellcore's SMDS defined by European Telecommunications Standards Institute (ETSI).

Connectionless Service - a type of service in which no pre-determined path or link has been established for transfer of information, supported by AAL 4.

Connectionless Service (CLS) - A service which allows the transfer of information among service subscribers without the need for end-to- end establishment procedures.

Connection-Oriented Service - a type of service in which information always traverses the same pre-established path or link between two points, supported by AAL 3.

Constant Bit Rate (CBR) - a type of traffic that requires a continuous, specific amount of bandwidth over the ATM network (e.g., digital information such as video and digitized voice).

Controlled Slip (CS) - a situation in which one frame's worth of data is either lost or replicated. A controlled slip typically occurs when the sending device and receiving device are not using the same clock.

Convergence Sublayer (CS) - a portion of the AAL. Data is passed first to the CS where it is divided into rational, fixed-length packets or PDUs (Protocol Data Units). For example, AAL 4 processes user data into blocks that are a maximum of 64 kbytes long.

Corresponding Entities - peer entities with a lower layer connection among them.

cpath - a FORE program used to manage virtual paths on a *ForeRunner* switch running asxd.

cport - a FORE program that monitors and changes the state of ports on a *ForeRunner* switch running `asxd`.

Cross Connection - a mapping between two channels or paths at a network device.

Customer Premise Equipment (CPE) - equipment that is on the customer side of the point of demarcation, as opposed to equipment that is on a carrier side. See also point of demarcation.

Cut Through - Establishment of a complete path for signaling and/or audio communications.

Cyclic Redundancy Check (CRC) - an error detection scheme in which a number is derived from the data that will be transmitted. By recalculating the CRC at the remote end and comparing it to the value originally transmitted, the receiving node can detect errors.

D3/D4 - Refers to compliance with AT&T TR (Technical Reference) 62411 definitions for coding, supervision, and alarm support. D3/D4 compatibility ensures support of digital PBXes, M24 services, Megacom services, and Mode 3 D3/D4 channel banks at DS-1 level.

D4 Channelization - refers to compliance with AT&T Technical Reference 62411 regarding DS1 frame layout (the sequential assignment of channels and time slot numbers within the DS1).

D4 Framed/Framing Format - in T1, a 193-bit frame format in which the 193rd bit is used for framing and signaling information (the frame/framing bit). To be considered in support of D4 Framing, a device must be able to synchronize and frame-up on the 193rd bit.

Data Communications Equipment (DCE) - a definition in the RS232C standard that describes the functions of the signals and the physical characteristics of an interface for a communication device such as a modem.

Data Country Code (DCC) - This specifies the country in which an address is registered. The codes are given in ISO 3166. The length of this field is two octets. The digits of the data country code are encoded in Binary Coded Decimal (BCD) syntax. The codes will be left justified and padded on the right with the hexadecimal value “F” to fill the two octets.

Data Link - Communications connection used to transmit data from a source to a destination.

Data Link Connection Identifier (DLCI) - connection identifier associated with frame relay packets that serves the same functions as, and translates directly to, the VPI/VCI on an ATM cell.

Data Link Layer - Layer 2 of the OSI model, responsible for encoding data and passing it to the physical medium. The IEEE divides this layer into the LLC (Logical Link Control) and MAC (Media Access Control) sublayers.

Data Set Ready (DSR) - an RS-232 modem interface control signal (sent from the modem to the DTE on pin 6) which indicates that the modem is connected to the telephone circuit. Usually a prerequisite to the DTE issuing RTS.

Data Terminal Equipment (DTE) - generally user devices, such as terminals and computers, that connect to data circuit-terminating equipment. They either generate or receive the data carried by the network.

Data Terminal Ready (DTR) - an RS232 modem interface control signal (sent from the DTE to the modem on pin 20) which indicates that the DTE is ready for data transmission and which requests that the modem be connected to the telephone circuit.

Datagram - a packet of information used in a connectionless network service that is routed to its destination using an address included in the datagram’s header.

DECnet - Digital Equipment Corporation's proprietary LAN.

Defense Advanced Research Projects Agency (DARPA) - the US government agency that funded the ARPANET.

Demultiplexing - a function performed by a layer entity that identifies and separates SDUs from a single connection to more than one connection (see *multiplexing*).

Destination End Station (DES) - An ATM termination point which is the destination for ATM messages of a connection and is used as a reference point for ABR services. See SES.

Digital Access and Cross-Connect System (DACS) - Digital switching system for routing T1 lines, and DS-0 portions of lines, among multiple T1 ports.

Digital Cross-connect System (DCS) - an electronic patch panel used to route digital signals in a central office.

Digital Standard n (0, 1, 1C, 2, and 3) (DSn) - a method defining the rate and format of digital hierarchy, with asynchronous data rates defined as follows:

DS0	64kb/s	1 voice channel
DS1	1.544Mb/s	24 DS0s
DS1C	3.152 Mb/s	2 DS1s
DS2	6.312 Mb/s	4 DS1s
DS3	44.736 Mb/s	28 DS1s

Synchronous data rates (SONET) are defined as:

STS-1/OC-1	51.84 Mb/s	28 DS1s or 1 DS3
STS-3/OC-3	155.52 Mb/s	3 STS-1s byte interleaved
STS-3c/OC-3c	155.52 Mb/s	Concatenated, indivisible payload
STS-12/OC-12	622.08 Mb/s	12 STS-1s, 4 STS-3cs, or any mixture
STS-12c/OC-12c	622.08 Mb/s	Concatenated, indivisible payload
STS-48/OC-48	2488.32 Mb/s	48 STS-1s, 16 STS-3cs, or any mixture

DIP (Dual In-line Package) Switch - a device that has two parallel rows of contacts that let the user switch electrical current through a pair of those contacts to on or off. They are used to reconfigure components and peripherals.

Domain Name Server - a computer that converts names to their corresponding Internet numbers. It allows users to telnet or FTP to the name instead of the number.

Domain Naming System (DNS) - the distributed name and address mechanism used in the Internet.

Duplex - Two way communication.

DXI - a generic phrase used in the full names of several protocols, all commonly used to allow a pair of DCE and DTE devices to share the implementation of a particular WAN protocol. The protocols define the packet formats used to transport data between DCE and DTE devices.

DXI Frame Address (DFA) - a connection identifier associated with ATM DXI packets that serves the same functions as, and translates directly to, the VPI/VCI on an ATM cell.

Dynamic Allocation - A technique in which the resources assigned for program execution are determined by criteria applied at the moment of need.

E.164 - A public network addressing standard utilizing up to a maximum of 15 digits. ATM uses E.164 addressing for public network addressing.

E1 - Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 2.048 Mbps. E1 lines can be leased for private use from common carriers.

E3 - Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 34.368 Mbps. E3 lines can be leased for private use from common carriers.

Edge Device - A physical device which is capable of forwarding packets between legacy interworking interfaces (e.g., Ethernet, Token Ring, etc.) and ATM interfaces based on data-link and network layer information but which does not participate in the running of any network layer routing protocol. An Edge Device obtains forwarding descriptions using the route distribution protocol.

elarp - a FORE program that shows and manipulates MAC and ATM address mappings for LAN Emulation Clients (LECs).

elconfig - a FORE program that shows and modifies LEC configuration. Lets the user set the NSAP address of the LAN Emulation Configuration Server, display the list of Emulated LANs configured in the LECS for this host, display the list of ELANs locally configured along with the membership state of each, and locally administer ELAN membership.

Electrically Erasable Programmable Read Only Memory (EEPROM) - an EPROM that can be cleared with electrical signals rather than the traditional ultraviolet light.

Electromagnetic Interference (EMI) - signals generated and radiated by an electronic device that cause interference with radio communications, among other effects.

Electronics Industries Association (EIA) - a USA trade organization that issues its own standards and contributes to ANSI; developed RS-232. Membership includes USA manufacturers.

Embedded SNMP Agent - an SNMP agent can come in two forms: embedded or proxy. An embedded SNMP agent is integrated into the physical hardware and software of the unit.

Emulated Local Area Network (ELAN) - A logical network initiated by using the mechanisms defined by LAN Emulation. This could include ATM and legacy attached end stations.

End System (ES) - a system where an ATM connection is terminated or initiated (an originating end system initiates the connection; a terminating end system terminates the connection).

End System Identifier (ESI) - This identifier distinguishes multiple nodes at the same level in case the lower level peer group is partitioned.

End-to-End Connection - when used in reference to an ATM network, a connection that travels through an ATM network, passing through various ATM devices and with endpoints at the termination of the ATM network.

Enterprise - Terminology generally referring to customers with multiple, non-contiguous geographic locations.

Equalization (EQL) - the process of compensating for line distortions.

Erasable Programmable Read Only Memory (EPROM) - A PROM which may be erased and rewritten to perform new or different functions (normally done with a PROM burner).

Errored Second (ES) - a second during which at least one code violation occurred.

Ethernet - a 10-Mbps, coaxial standard for LANs in which all nodes connect to the cable where they contend for access.

Excessive Zeroes (EXZ) Error Event - An Excessive Zeroes error event for an AMI-coded signal is the occurrence of more than fifteen contiguous zeroes. For a B8ZS coded signal, the defect occurs when more than seven contiguous zeroes are detected.

Explicit Forward Congestion Indication (EFCI) - the second bit of the payload type field in the header of an ATM cell, the EFCI bit indicates network congestion to receiving hosts. On a congested switch, the EFCI bit is set to “1” by the transmitting network module when a certain number of cells have accumulated in the network module's shared memory buffer. When a cell is received that has its EFCI bit set to “1,” the receiving host notifies the sending host, which should then reduce its transmission rate.

Explicit Rate (ER) - The Explicit Rate is an RM-cell field used to limit the source ACR to a specific value. It is initially set by the source to a requested rate (such as PCR). It may be subsequently reduced by any network element in the path to a value that the element can sustain. ER is formatted as a rate.

Extended Industry Standard Architecture (EISA) - bus architecture for desktop computers that provides a 32-bit data passage and maintains compatibility with the ISA or AT architecture.

Extended Super Frame (ESF) - a T1 framing format that utilizes the 193rd bit as a framing bit, but whose Superframe is made up of 24 frames instead of 12 as in D4 format. ESF also provides CRC error detection and maintenance data link functions.

Exterior Gateway Protocol (EGP) - used by gateways in an internet, connecting autonomous networks.

Fairness - related to Generic Flow Control, fairness is defined as meeting all of the agreed quality of service requirements by controlling the order of service for all active connections.

Far End Block Error (FEBE) - an error detected by extracting the 4-bit FEBE field from the path status byte (G1). The legal range for the 4-bit field is between 0000 and 1000, representing zero to eight errors. Any other value is interpreted as zero errors.

Far End Receive Failure (FERF) - a line error asserted when a 110 binary pattern is detected in bits 6, 7, 8 of the K2 byte for five consecutive frames. A line FERF is removed when any pattern other than 110 is detected in these bits for five consecutive frames.

Far-End - in a relationship between two devices in a circuit, the far-end device is the one that is remote.

Face Contact (FC) - Designation for fiber optic connector designed by Nippon Telegraph and Telephone which features a movable anti-rotation key allowing good repeatable performance despite numerous mating. Normally referred to as Fiber Connector, FC actually stands for Face Contact and sometimes linked with PC (Point Contact), designated as FC or FC-PC.

FCC Part 68 - The FCC rules regulating the direct connection of non-telephone company provided equipment to the public telephone network.

Federal Communications Commission (FCC) - a board of commissioners appointed by the President under the Communications Act of 1934, with the authority to regulate all interstate telecommunications originating in the United States, including transmission over phone lines.

Fiber Distributed Data Interface (FDDI) - high-speed data network that uses fiber-optic as the physical medium. Operates in similar manner to Ethernet or Token Ring, only faster.

File Transfer Protocol (FTP) - a TCP/IP protocol that lets a user on one computer access, and transfer data to and from, another computer over a network. ftp is usually the name of the program the user invokes to accomplish this task.

First-In, First-Out (FIFO) - method of coordinating the sequential flow of data through a buffer.

Flag - a bit pattern of six binary “1”s bounded by a binary “0” at each end (forms a 0111 1110 or Hex “7E”). It is used to mark the beginning and/or end of a frame.

Flow Control - The way in which information is controlled in a network to prevent loss of data when the receiving buffer is near its capacity.

***ForeThought* PNNI (FT-PNNI) -** a FORE Systems routing and signalling protocol that uses private ATM (NSAP) addresses; a precursor to ATM Forum PNNI (see PNNI).

Forward Error Correction (FEC) - A technique used by a receiver for correcting errors incurred in transmission over a communications channel without requiring retransmission of any information by the transmitter; typically involves a convolution of the transmitted bits and the appending of extra bits by both the receiver and transmitter using a common algorithm.

Forward Explicit Congestion Notification (FECN) - Bit set by a Frame Relay network to inform data terminal equipment (DTE) receiving the frame that congestion was experienced in the path from source to destination. DTE receiving frames with the FECN bit set can request that higher-level protocols take flow control action as appropriate.

Fractional T1 - the use of bandwidth in 64Kbps increments up to 1.544Mbps from a T1 facility.

Frame - a variable length group of data bits with a specific format containing flags at the beginning and end to provide demarcation.

Frame Check Sequence (FCS) - In bit-oriented protocols, a 16-bit field that contains transmission error checking information, usually appended to the end of the frame.

Frame Relay - a fast packet switching protocol based on the LAPD protocol of ISDN that performs routing and transfer with less overhead processing than X.25.

Frame Synchronization Error - an error in which one or more time slot framing bits are in error.

Frame-Based UNI (FUNI) - An ATM switch-based interface which accepts frame-based ATM traffic and converts it into cells.

Frame-Relay Service (FRS) - A connection oriented service that is capable of carrying up to 4096 bytes per frame.

Framing - a protocol that separates incoming bits into identifiable groups so that the receiving multiplexer recognizes the grouping.

Frequency Division Multiplexing (FDM) - a method of dividing an available frequency range into parts with each having enough bandwidth to carry one channel.

Gbps - gigabits per second (billion)

Generic Cell Rate Algorithm (GCRA) - an algorithm which is employed in traffic policing and is part of the user/network service contract. The GCRA is a scheduling algorithm which ensures that cells are marked as conforming when they arrive when expected or later than expected and non-conforming when they arrive sooner than expected.

Generic Connection Admission Control (GCAC) - This is a process to determine if a link has potentially enough resources to support a connection.

Generic Flow Control (GFC) - the first four bits of the first byte in an ATM cell header. Used to control the flow of traffic across the User-to-Network Interface (UNI), and thus into the network. Exact mechanisms for flow control are still under investigation and no explicit definition for this field exists at this time. (This field is used only at the UNI; for NNI-NNI use (between network nodes), these four bits provide additional network address capacity, and are appended to the VPI field.)

GIO - a proprietary bus architecture used in certain Silicon Graphics, Inc. workstations.

Header - protocol control information located at the beginning of a protocol data unit.

Header Error Control (HEC) - a CRC code located in the last byte of an ATM cell header that is used for checking cell header integrity only.

High Density Bipolar (HDB3) - A bipolar coding method that does not allow more than 3 consecutive zeroes.

High Level Data Link Control (HDLC) - An ITU-TSS link layer protocol standard for point-to-point and multi-point communications.

High Performance Parallel Interface (HIPPI) - ANSI standard that extends the computer bus over fairly short distances at speeds of 800 and 1600 Mbps.

High-Speed Serial Interface (HSSI) - a serial communications connection that operates at speeds of up to 1.544 Mbps.

Host - In a network, the primary or controlling computer in a multiple computer installation.

HPUX - the Hewlett-Packard version of UNIX.

Hub - a device that connects several other devices, usually in a star topology.

I/O Module - FORE's interface cards for the LAX-20 LAN Access Switch, designed to connect Ethernet, Token Ring, and FDDI LANs to *ForeRunner* ATM networks.

Institute of Electrical and Electronics Engineers (IEEE) - the world's largest technical professional society. Based in the U.S., the IEEE sponsors technical conferences, symposia & local meetings worldwide, publishes nearly 25% of the world's technical papers in electrical, electronics & computer engineering, provides educational programs for members, and promotes standardization.

IEEE 802 - Standards for the interconnection of LAN computer equipment. Deals with the Data Link Layers of the ISO Reference Model for OSI.
IEEE 802.1 - Defines the high-level network interfaces such as architecture, internetworking and network management.
IEEE 802.2 - Defines the Logical Link Control interface between the Data Link and Network Layers.
IEEE 802.3 - Defines CSMA/CD (Ethernet).
IEEE 802.4 - Defines the token-passing bus.
IEEE 802.5 - Defines the Token Ring access methodology. This standard incorporates IBM's Token Ring specifications.
IEEE 802.6 - Defines Metropolitan Area Networks.
IEEE 802.7 - The broadband technical advisory group.
IEEE 802.8 - The fiber optics technical advisory group.
IEEE 802.9 - Defines integrated data and voice networks.

Integrated Services Digital Network (ISDN) - an emerging technology that is beginning to be offered by the telephone carriers of the world. ISDN combines voice and digital network services into a single medium or wire.

Interexchange Carriers (IXC) - Long-distance communications companies that provide service between Local Access Transport Areas (LATAs).

Interface Data - the unit of information transferred to/from the upper layer in a single interaction across a SAP. Each Interface Data Unit (IDU) controls interface information and may also contain the whole or part of the SDU.

Interface Data Unit (IDU) - The unit of information transferred to/from the upper layer in a single interaction across the SAP. Each IDU contains interface control information and may also contain the whole or part of the SDU.

Interim Local Management Interface (ILMI) - the standard that specifies the use of the Simple Network Management Protocol (SNMP) and an ATM management information base (MIB) to provide network status and configuration information.

Intermediate System (IS) - a system that provides forwarding functions or relaying functions or both for a specific ATM connection. OAM cells may be generated and received.

International Standards Organization (ISO) - a voluntary, non treaty organization founded in 1946 that is responsible for creating international standards in many areas, including computers and communications.

International Telephone and Telegraph Consultative Committee (CCITT) - the international standards body for telecommunications.

Internet - (note the capital “I”) the largest internet in the world including large national backbone nets and many regional and local networks worldwide. The Internet uses the TCP/IP suite. Networks with only e-mail connectivity are not considered on the Internet.

internet - while an internet is a network, the term “internet” is usually used to refer to a collection of networks interconnected with routers.

Internet Addresses - the numbers used to identify hosts on an internet network. Internet host numbers are divided into two parts; the first is the network number and the second, or local, part is a host number on that particular network. There are also three classes of networks in the Internet, based on the number of hosts on a given network. Large networks are classified as Class A, having addresses in the range 1-126 and having a maximum of 16,387,064 hosts. Medium networks are classified as Class B, with addresses in the range 128-191 and with a maximum of 64,516 hosts. Small networks are classified as Class C, having addresses in the range 192-254 with a maximum of 254 hosts. Addresses are given as dotted decimal numbers in the following format:

nnn.nnn.nnn.nnn

In a Class A network, the first of the numbers is the network number, the last three numbers are the local host address.

In a Class B network, the first two numbers are the network, the last two are the local host address.

In a Class C network, the first three numbers are the network address, the last number is the local host address.

The following table summarizes the classes and sizes:

Class	First #	Max# Hosts
A	1-126	16,387,064
B	129-191	64,516
C	192-223	254

Network mask values are used to identify the network portion and the host portion of the address. Default network masks are as follows:

Class A - 255.0.0.0

Class B - 255.255.0.0

Class C - 255.255.255.0

Subnet masking is used when a portion of the host ID is used to identify a subnetwork. For example, if a portion of a Class B network address is used for a subnetwork, the mask could be set as 255.255.255.0. This would allow the third byte to be used as a subnetwork address. All hosts on the network would still use the IP address to get on the Internet.

Internet Control Message Protocol (ICMP) - the protocol that handles errors and control messages at the IP layer. ICMP is actually a part of the IP protocol layer. It can generate error messages, test packets, and informational messages related to IP.

Internet Engineering Task Force (IETF) - a large, open, international community of network designers, operators, vendors and researchers whose purpose is to coordinate the operation, management and evolution of the Internet to resolve short- and mid-range protocol and architectural issues.

Internet Protocol (IP) - a connectionless, best-effort packet switching protocol that offers a common layer over dissimilar networks.

Internetwork Packet Exchange (IPX) Protocol - a NetWare protocol similar to the Xerox Network Systems (XNS) protocol that provides datagram delivery of messages.

Interoperability - The ability of software and hardware on multiple machines, from multiple vendors, to communicate.

Interworking Function (IWF) - provides a means for two different technologies to interoperate.

IP Address - a unique 32-bit integer used to identify a device in an IP network. You will most commonly see IP addresses written in “dot” notation (e.g., 192.228.32.14).

IP Netmask - a 32-bit pattern that is combined with an IP address to determine which bits of an IP address denote the network number and which denote the host number. Netmasks are useful for sub-dividing IP networks. IP netmasks are written in “dot” notation (e.g., 255.255.0.0).

ISA Bus - a bus standard developed by IBM for expansion cards in the first IBM PC. The original bus supported a data path only 8 bits wide. IBM subsequently developed a 16-bit version for its AT class computers. The 16-bit AT ISA bus supports both 8- and 16-bit cards. The 8-bit bus is commonly called the PC/XT bus, and the 16-bit bus is called the AT bus.

Isochronous - signals carrying embedded timing information or signals that are dependent on uniform timing; usually associated with voice and/or video transmission.

International Telecommunications Union Telecommunications (ITU-T) - an international body of member countries whose task is to define recommendations and standards relating to the international telecommunications industry. The fundamental standards for ATM have been defined and published by the ITU-T (Previously CCITT).

J2 - Wide-area digital transmission scheme used predominantly in Japan that carries data at a rate of 6.312 Mbps.

Jitter - analog communication line distortion caused by variations of a signal from its reference timing position.

Joint Photographic Experts Group (JPEG) - An ISO Standards group that defines how to compress still pictures.

Jumper - a patch cable or wire used to establish a circuit, often temporarily, for testing or diagnostics; also, the devices, shorting blocks, used to connect adjacent exposed pins on a printed circuit board that control the functionality of the card.

Kbps - kilobits per second (thousand)

LAN Access Concentrator - a LAN access device that allows a shared transmission medium to accommodate more data sources than there are channels currently available within the transmission medium.

LAN Emulation Address Resolution Protocol (LE_ARP) - A message issued by a LE client to solicit the ATM address of another function.

LAN Emulation Client (LEC) - the component in an end system that performs data forwarding, address resolution, and other control functions when communicating with other components within an ELAN.

LAN Emulation Configuration Server (LECS) - the LECS is responsible for the initial configuration of LECs. It provides information about available ELANs that a LEC may join, together with the addresses of the LES and BUS associated with each ELAN.

LAN Emulation Server (LES) - the LES implements the control coordination function for an ELAN by registering and resolving MAC addresses to ATM addresses.

LAN Emulation (LANE) - technology that allows an ATM network to function as a LAN backbone. The ATM network must provide multicast and broadcast support, address mapping (MAC-to-ATM), SVC management, and a usable packet format. LANE also defines Ethernet and Token Ring ELANs.

lane - a program that provides control over the execution of the LAN Emulation Server (LES), Broadcast/Unknown Server (BUS), and LAN Emulation Configuration Server (LECS) on the local host.

Latency - The time interval between a network station seeking access to a transmission channel and that access being granted or received.

Layer Entity - an active layer within an element.

Layer Function - a part of the activity of the layer entities.

Layer Service - a capability of a layer and the layers beneath it that is provided to the upper layer entities at the boundary between that layer and the next higher layer.

Layer User Data - the information transferred between corresponding entities on behalf of the upper layer or layer management entities for which they are providing services.

le - a FORE program that implements both the LAN Emulation Server (LES) and the Broadcast/Unknown Server (BUS).

Leaky Bucket - informal cell policing term for the Generic Cell Rate Algorithm which in effect receives cells into a bucket and leaks them out at the specified or contracted rate (i.e., PCR).

Least Significant Bit (LSB) - lowest order bit in the binary representation of a numerical value.

lecs - a FORE program that implements the assignment of individual LECs to different emulated LANs.

leq - a FORE program that provides information about an ELAN. This information is obtained from the LES, and includes MAC addresses registered on the ELAN together with their corresponding ATM addresses.

Line Build Out (LBO) - Because T1 circuits require the last span to lose 15-22.5 dB, a selectable output attenuation is generally required of DTE equipment (typical selections include 0.0, 7.5 and 15 dB of loss at 772 KHz).

Line Code Violations (LCV) - Error Event. A Line Coding Violation (LCV) is the occurrence of either a Bipolar Violation (BPV) or Excessive Zeroes (EXZ) Error Event.

Link - An entity that defines a topological relationship (including available transport capacity) between two nodes in different subnetworks. Multiple links may exist between a pair of subnetworks. Synonymous with logical link.

Link Access Procedure, Balanced (LAPB) - Data link protocol in the X.25 protocol stack. LAPB is a bit-oriented protocol derived from HDLC. See also HDLC and X.25.

Link Down Trap - an SNMP trap, sent when an interface changes from a normal state to an error state, or is disconnected.

Link Layer - layer in the OSI model regarding transmission of data between network nodes.

Link Up Trap - an SNMP trap, sent when an interface changes from an error condition to a normal state.

Load Sharing - Two or more computers in a system that share the load during peak hours. During periods of non peak hours, one computer can manage the entire load with the other acting as a backup.

Local Access and Transport Area (LATA) - Geographic boundaries of the local telephone network, specified by the FCC, in which a single LEC may perform its operations. Communications outside or between LATAs are provided by IXCs.

Local Area Network (LAN) - a data network intended to serve an area of only a few square kilometers or less. Because the network is known to cover only a small area, optimizations can be made in the network signal protocols that permit higher data rates.

Logical Link Control (LLC) - protocol developed by the IEEE 802 committee for data-link-layer transmission control; the upper sublayer of the IEEE Layer 2 (OSI) protocol that complements the MAC protocol; IEEE standard 802.2; includes end-system addressing and error checking.

Loopback - a troubleshooting technique that returns a transmitted signal to its source so that the signal can be analyzed for errors. Typically, a loopback is set at various points in a line until the section of the line that is causing the problem is discovered.

looptest - program that tests an interface for basic cell reception and transmission functionality, usually used for diagnostic purposes to determine if an interface is functioning properly.

Loss Of Frame (LOF) - a type of transmission error that may occur in wide-area carrier lines.

Loss Of Pointer (LOP) - a type of transmission error that may occur in wide-area carrier lines.

Loss Of Signal (LOS) - a type of transmission error that may occur in wide-area carrier lines, or a condition declared when the DTE senses a loss of a DS1 signal from the CPE for more the 150 milliseconds (the DTE generally responds with an all ones “Blue or AIS” signal).

Management Information Base (MIB) - the set of parameters that an SNMP management station can query or set in the SNMP agent of a networked device (e.g., router).

Maximum Burst Size (MBS) - the Burst Tolerance (BT) is conveyed through the MBS which is coded as a number of cells. The BT together with the SCR and the GCRA determine the MBS that may be transmitted at the peak rate and still be in conformance with the GCRA.

Maximum Burst Tolerance - the largest burst of data that a network device is guaranteed to handle without discarding cells or packets. Bursts of data larger than the maximum burst size may be subject to discard.

Maximum Cell Delay Variance (MCDV) - This is the maximum two-point CDV objective across a link or node for the specified service category.

Maximum Cell Loss Ratio (MCLR) - This is the maximum ratio of the number of cells that do not make it across the link or node to the total number of cells arriving at the link or node.

Maximum Cell Transfer Delay (MCTD) - This is the sum of the fixed delay component across the link or node and MCDV.

Maximum Transmission Unit (MTU) - the largest unit of data that can be sent over a type of physical medium.

Mbps - megabits per second (million)

Media Access Control (MAC) - a media-specific access control protocol within IEEE 802 specifications; currently includes variations for Token Ring, token bus, and CSMA/CD; the lower sublayer of the IEEE’s link layer (OSI), which complements the Logical Link Control (LLC).

Media Attachment Unit (MAU) - device used in Ethernet and IEEE 802.3 networks that provides the interface between the AUI port of a station and the common medium of the Ethernet. The MAU, which can be built into a station or can be a separate device, performs physical layer functions including conversion of the digital data from the Ethernet interface, collision detection, and injection of bits onto the network.

Media Interface Connector (MIC) - fiber optic connector that joins fiber to the FDDI controller.

Message Identifier (MID) - message identifier used to associate ATM cells that carry segments from the same higher layer packet.

Metasignalling - an ATM Layer Management (LM) process that manages different types of signalling and possibly semipermanent virtual channels (VCs), including the assignment, removal, and checking of VCs.

Metasignalling VCs - the standardized VCs that convey metasignalling information across a User-to-Network Interface (UNI).

Metropolitan Area Network (MAN) - network designed to carry data over an area larger than a campus such as an entire city and its outlying area.

MicroChannel - a proprietary 16- or 32-bit bus developed by IBM for its PS/2 computers' internal expansion cards; also offered by others.

Minimum Cell Rate (MCR) - parameter defined by the ATM Forum for ATM traffic management, defined only for ABR transmissions and specifying the minimum value for the ACR.

Most Significant Bit (MSB) - highest order bit in the binary representation of a numerical value.

Motion Picture Experts Group (MPEG) - ISO group dealing with video and audio compression techniques and mechanisms for multiplexing and synchronizing various media streams.

MPOA Client - A device which implements the client side of one or more of the MPOA protocols, (i.e., is a SCP client and/or an RDP client. An MPOA Client is either an Edge Device Functional Group (EDFG) or a Host Behavior Functional Group (HBFG).

MPOA Server - An MPOA Server is any one of an ICFG or RSFG.

MPOA Service Area - The collection of server functions and their clients. A collection of physical devices consisting of an MPOA server plus the set of clients served by that server.

MPOA Target - A set of protocol address, path attributes, (e.g., internetwork layer QoS, other information derivable from received packet) describing the intended destination and its path attributes that MPOA devices may use as lookup keys.

Mu-Law - The PCM coding and companding standard used in Japan and North America.

Multicasting - The ability to broadcast messages to one node or a select group of nodes.

Multi-homed - a device having both an ATM and another network connection, like Ethernet.

Multimode Fiber Optic Cable (MMF) - fiber optic cable in which the signal or light propagates in multiple modes or paths. Since these paths may have varying lengths, a transmitted pulse of light may be received at different times and smeared to the point that pulses may interfere with surrounding pulses. This may cause the signal to be difficult or impossible to receive. This pulse dispersion sometimes limits the distance over which a MMF link can operate.

Multiplexing - a function within a layer that interleaves the information from multiple connections into one connection (see demultiplexing).

Multipoint Access - user access in which more than one terminal equipment (TE) is supported by a single network termination.

Multipoint-to-Multipoint Connection - a collection of associated ATM VC or VP links, and their associated endpoint nodes, with the following properties:

1. All N nodes in the connection, called Endpoints, serve as a Root Node in a Point-to-Multipoint connection to all of the (N-1) remaining endpoints.
2. Each of the endpoints can send information directly to any other endpoint, but the receiving endpoint cannot distinguish which of the endpoints is sending information without additional (e.g., higher layer) information.

Multipoint-to-Point Connection - a Point-to-Multipoint Connection may have zero bandwidth from the Root Node to the Leaf Nodes, and non-zero return bandwidth from the Leaf Nodes to the Root Node. Such a connection is also known as a Multipoint-to-Point Connection.

Multiprotocol over ATM (MPOA) - An effort taking place in the ATM Forum to standardize protocols for the purpose of running multiple network layer protocols over ATM.

Narrowband Channel - sub-voicegrade channel with a speed range of 100 to 200 bps.

National TV Standards Committee (NTSC) - Started in the US in 1953 from a specification laid down by the National Television Standards Committee. It takes the B-Y and R-Y color difference signals, attenuates them to I and Q, then modulates them using double-sideband suppressed subcarrier at 3.58MHz. The carrier reference is sent to the receiver as a burst during the back porch. An industry group that defines how television signals are encoded and transmitted in the US. (See also PAL, SECAM for non-U.S. countries).

Near-End - in a relationship between two devices in a circuit, the near-end device is the one that is local.

Network Layer - Layer three In the OSI model, the layer that is responsible for routing data across the network.

Network Management Entity (NM) - body of software in a switching system that provides the ability to manage the PNNI protocol. NM interacts with the PNNI protocol through the MIB.

Network Management Layer (NML) - an abstraction of the functions provided by systems which manage network elements on a collective basis, providing end-to-end network monitoring.

Network Management Station (NMS) - system responsible for managing a network or portion of a network by talking to network management agents, which reside in the managed nodes.

Network Module - ATM port interface cards which may be individually added to or removed from any *ForeRunner* ATM switch to provide a diverse choice of connection alternatives.

Network Parameter Control (NPC) - Defined as the set of actions taken by the network to monitor and control traffic from the NNI. Its main purpose is to protect network resources from malicious as well as unintentional misbehavior which can affect the QoS of other already established connections by detecting violations of negotiated parameters and taking appropriate actions. Refer to UPC.

Network Redundancy - Duplicated network equipment and/or data which can provide a backup in case of network failures.

Network Service Access Point (NSAP) - OSI generic standard for a network address consisting of 20 octets. ATM has specified E.164 for public network addressing and the NSAP address structure for private network addresses.

Network-to-Network Interface or Network Node Interface (NNI) - the interface between two public network pieces of equipment.

Node - A computer or other device when considered as part of a network.

Non Return to Zero (NRZ) - a binary encoding scheme in which ones and zeroes are represented by opposite and alternating high and low voltages and where there is no return to a zero (reference) voltage between encoded bits.

Non Return to Zero Inverted (NRZI) - A binary encoding scheme that inverts the signal on a “1” and leaves the signal unchanged for a “0”. (Also called transition encoding.)

Nonvolatile Storage - Memory storage that does not lose its contents when power is turned off.

NuBus - a high-speed bus used in Macintosh computers, structured so users can put a card into any slot on the board without creating conflict over the priority between those cards.

nx64K - This refers to a circuit bandwidth or speed provided by the aggregation of nx64 kbps channels (where n= integer > 1). The 64K or DS0 channel is the basic rate provided by the T Carrier systems.

Nyquist Theorem - In communications theory, a formula stating that two samples per cycle is sufficient to characterize a bandwidth limited analog signal; in other words, the sampling rate must be twice the highest frequency component of the signal (i.e., sample 4 KHz analog voice channels 8000 times per second).

Object Identifier (OID) - the address of a MIB variable.

Octet - a grouping of 8 bits; similar, but not identical to, a byte.

One’s Density - The requirement for digital transmission lines in the public switched telephone network that eight consecutive “0”s cannot be in a digital data stream; exists because repeaters and clocking devices within the network will lose timing after receiving eight “0”s in a row; a number of techniques are used to insert a “1” after every seventh-consecutive “0” (see Bit Stuffing).

Open Shortest Path First (OSPF) Protocol - a routing algorithm for IP that incorporates least-cost, equal-cost, and load balancing.

Open Systems Interconnection (OSI) - the 7-layer suite of protocols designed by ISO committees to be the international standard computer network architecture.

OpenView - Hewlett-Packard's network management software.

Operation and Maintenance (OAM) Cell - a cell that contains ATM LM information. It does not form part of the upper layer information transfer.

Optical Carrier level-n (OC-n) - The optical counterpart of STS-n (the basic rate of 51.84 Mbps on which SONET is based is referred to as OC-1 or STS-1).

Organizationally Unique Identifier (OUI) - Part of RFC 1483. A three-octet field in the SubNetwork Attachment Point (SNAP) header, identifying an organization which administers the meaning of the following two octet Protocol Identifier (PID) field in the SNAP header. Together they identify a distinct routed or bridged protocol.

Out-of-Band Management - refers to switch configuration via the serial port or over Ethernet, not ATM.

Out-of-Frame (OOF) - a signal condition and alarm in which some or all framing bits are lost.

Packet - An arbitrary collection of data grouped and transmitted with its user identification over a shared facility.

Packet Assembler Disassembler (PAD) - interface device that buffers data sent to/from character mode devices, and assembles and disassembles the packets needed for X.25 operation.

Packet Internet Groper (ping) - a program used to test reachability of destinations by sending them an ICMP echo request and waiting for a reply.

Packet Level Protocol (PLP) - Network layer protocol in the X.25 protocol stack. Sometimes called X.25 Level 3 or X.25 Protocol.

Packet Switched Network (PSN) - a network designed to carry data in the form of packets. The packet and its format is internal to that network.

Packet Switching - a communications paradigm in which packets (messages) are individually routed between hosts with no previously established communications path.

Payload Scrambling - a technique that eliminates certain bit patterns that may occur within an ATM cell payload that could be misinterpreted by certain sensitive transmission equipment as an alarm condition.

Payload Type (PT) - bits 2...4 in the fourth byte of an ATM cell header. The PT indicates the type of information carried by the cell. At this time, values 0...3 are used to identify various types of user data, values 4 and 5 indicate management information, and values 6 and 7 are reserved for future use.

Peak Cell Rate - at the PHY Layer SAP of a point-to-point VCC, the Peak Cell Rate is the inverse of the minimum inter-arrival time T0 of the request to send an ATM-SDU.

Peak Cell Rate (PCR) - parameter defined by the ATM Forum for ATM traffic management. In CBR transmissions, PCR determines how often data samples are sent. In ABR transmissions, PCR determines the maximum value of the ACR.

Peer Entities - entities within the same layer.

Peripheral Component Interconnect (PCI) - a local-bus standard created by Intel.

Permanent Virtual Channel Connection (PVCC) - A Virtual Channel Connection (VCC) is an ATM connection where switching is performed on the VPI/VCI fields of each cell. A Permanent VCC is one which is provisioned through some network management function and left up indefinitely.

Permanent Virtual Circuit (or Channel) (PVC) - a circuit or channel through an ATM network provisioned by a carrier between two endpoints; used for dedicated long-term information transport between locations.

Permanent Virtual Path Connection (PVPC) - A Virtual Path Connection (VPC) is an ATM connection where switching is performed on the VPI field only of each cell. A PVPC is one which is provisioned through some network management function and left up indefinitely.

Phase Alternate Line (PAL) - Largely a German/British development in the late 60s, used in the UK and much of Europe. The B-Y and R-Y signals are weighted to U and V, then modulated onto a double-sideband suppressed subcarrier at 4.43MHz. The V (R-Y) signal's phase is turned through 180 degrees on each alternate line. This gets rid of NTSC’s hue changes with phase errors at the expense of de-saturation. The carrier reference is sent as a burst in the back porch. The phase of the burst is alternated every line to convey the phase switching of the V signal. The burst's average phase is -V. (see NTSC for U.S.).

Physical Layer (PHY) - the actual cards, wires, and/or fiber-optic cabling used to connect computers, routers, and switches.

Physical Layer Connection - an association established by the PHY between two or more ATM-entities. A PHY connection consists of the concatenation of PHY links in order to provide an end-to-end transfer capability to PHY SAPs.

Physical Layer Convergence Protocol (PLCP) - a framing protocol that runs on top of the T1 or E1 framing protocol.

Physical Medium (PM) - Refers to the actual physical interfaces. Several interfaces are defined including STS-1, STS-3c, STS-12c, STM-1, STM-4, DS1, E1, DS2, E3, DS3, E4, FDDI-based, Fiber Channel-based, and STP. These range in speeds from 1.544Mbps through 622.08 Mbps.

Physical Medium Dependent (PMD) - a sublayer concerned with the bit transfer between two network nodes. It deals with wave shapes, timing recovery, line coding, and electro-optic conversions for fiber based links.

Plesiochronous - two signals are plesiochronous if their corresponding significant instants occur at nominally the same rate, with variations in rate constrained to specified limits.

Point of Demarcation - the dividing line between a carrier and the customer premise that is governed by strict standards that define the characteristics of the equipment on each side of the demarcation. Equipment on one side of the point of demarcation is the responsibility of the customer. Equipment on the other side of the point of demarcation is the responsibility of the carrier.

Point-to-Multipoint Connection - a collection of associated ATM VC or VP links, with associated endpoint nodes, with the following properties:

1. One ATM link, called the Root Link, serves as the root in a simple tree topology. When the Root node sends information, all of the remaining nodes on the connection, called Leaf nodes, receive copies of the information.

2. Each of the Leaf Nodes on the connection can send information directly to the Root Node. The Root Node cannot distinguish which Leaf is sending information without additional (higher layer) information. (See the following note for Phase 1.)

3. The Leaf Nodes cannot communicate directly to each other with this connection type.

Note: Phase 1 signalling does not support traffic sent from a Leaf to the Root.

Point-to-Point Connection - a connection with only two endpoints.

Point-to-Point Protocol (PPP) - Provides a method for transmitting packets over serial point-to-point links.

Policing - the function that ensures that a network device does not accept traffic that exceeds the configured bandwidth of a connection.

Port Identifier - The identifier assigned by a logical node to represent the point of attachment of a link to that node.

Presentation Layer - Sixth layer of the OSI model, providing services to the application layer.

Primary Reference Source (PRS) - Equipment that provides a timing signal whose long-term accuracy is maintained at 1 x 10 -11 or better with verification to universal coordinated time (UTC) and whose timing signal is used as the basis of reference for the control of other clocks within a network.

Primitive - an abstract, implementation-independent interaction between a layer service user and a layer service provider.

Priority - the parameter of ATM connections that determines the order in which they are reduced from the peak cell rate to the sustained cell rate in times of congestion. Connections with lower priority (4 is low, 1 is high) are reduced first.

Private Branch Exchange (PBX) - a private phone system (switch) that connects to the public telephone network and offers in-house connectivity. To reach an outside line, the user must dial a digit like 8 or 9.

Private Network Node Interface or Private Network-to-Network Interface (PNNI) - a protocol that defines the interaction of private ATM switches or groups of private ATM switches

Programmable Read-Only Memory (PROM) - a chip-based information storage area that can be recorded by an operator but erased only through a physical process.

Protocol - a set of rules and formats (semantic and syntactic) that determines the communication behavior of layer entities in the performance of the layer functions.

Protocol Control Information - the information exchanged between corresponding entities using a lower layer connection to coordinate their joint operation.

Protocol Data Unit (PDU) - a unit of data specified in a layer protocol and consisting of protocol control information and layer user data.

Proxy - the process in which one system acts for another system to answer protocol requests.

Proxy Agent - an agent that queries on behalf of the manager, used to monitor objects that are not directly manageable.

Public Data Network (PDN) - a network designed primarily for data transmission and intended for sharing by many users from many organizations.

Pulse Code Modulation (PCM) - a modulation scheme that samples the information signals and transmits a series of coded pulses to represent the data.

Q.2931 - Derived from Q.93B, the narrowband ISDN signalling protocol, an ITU standard describing the signalling protocol to be used by switched virtual circuits on ATM LANs.

Quality of Service (QoS) - Quality of Service is defined on an end-to-end basis in terms of the following attributes of the end-to-end ATM connection:

Cell Loss Ratio
Cell Transfer Delay
Cell Delay Variation

Queuing Delay (QD) - refers to the delay imposed on a cell by its having to be buffered because of unavailability of resources to pass the cell onto the next network function or element. This buffering could be a result of oversubscription of a physical link, or due to a connection of higher priority or tighter service constraints getting the resource of the physical link.

Radio Frequency Interference (RFI) - the unintentional transmission of radio signals. Computer equipment and wiring can both generate and receive RFI.

Real-Time Clock - a clock that maintains the time of day, in contrast to a clock that is used to time the electrical pulses on a circuit.

Red Alarm - In T1, a red alarm is generated for a locally detected failure such as when a condition like OOF exists for 2.5 seconds, causing a CGA, (Carrier Group Alarm).

Reduced Instruction Set Computer (RISC) - a generic name for CPUs that use a simpler instruction set than more traditional designs.

Redundancy - In a data transmission, the fragments of characters and bits that can be eliminated with no loss of information.

Registration - The address registration function is the mechanism by which Clients provide address information to the LAN Emulation Server.

Relaying - a function of a layer by means of which a layer entity receives data from a corresponding entity and transmits it to another corresponding entity.

Request To Send (RTS) - an RS-232 modem interface signal (sent from the DTE to the modem on pin 4) which indicates that the DTE has data to transmit.

Requests For Comment (RFCs) - IETF documents suggesting protocols and policies of the Internet, inviting comments as to the quality and validity of those policies. These comments are collected and analyzed by the IETF in order to finalize Internet standards.

RFC1483 - Multiprotocol Encapsulation over ATM Adaptation Layer 5.
RFC1490 - Multiprotocol Interconnect over Frame Relay.
RFC1577 - Classical IP and ARP over ATM.
RFC1755 - ATM Signaling Support for IP over ATM.

Robbed-Bit Signaling - In T1, refers to the use of the least significant bit of every word of frames 6 and 12 (D4), or 6, 12, 18, and 24 (ESF) for signaling purposes.

Route Server - A physical device that runs one or more network layer routing protocols, and which uses a route query protocol in order to provide network layer routing forwarding descriptions to clients.

Router - a device that forwards traffic between networks or subnetworks based on network layer information.

Routing Domain (RD) - A group of topologically contiguous systems which are running one instance of routing.

Routing Information Protocol (RIP) - a distance vector-based protocol that provides a measure of distance, or hops, from a transmitting workstation to a receiving workstation.

Routing Protocol - A general term indicating a protocol run between routers and/or route servers in order to exchange information used to allow computation of routes. The result of the routing computation will be one or more forwarding descriptions.

SBus - hardware interface for add-in boards in later-version Sun 3 workstations.

Scalable Processor Architecture Reduced instruction set Computer (SPARC) - a powerful workstation similar to a reduced-instruction-set-computing (RISC) workstation.

Segment - a single ATM link or group of interconnected ATM links of an ATM connection.

Segmentation And Reassembly (SAR) - the SAR accepts PDUs from the CS and divides them into very small segments (44 bytes long). If the CS-PDU is less than 44 bytes, it is padded to 44 with zeroes. A two-byte header and trailer are added to this basic segment. The header identifies the message type (beginning, end, continuation, or single) and contains sequence numbering and message identification. The trailer gives the SAR-PDU payload length, exclusive of pad, and contains a CRC check to ensure the SAR-PDU integrity. The result is a 48-byte PDU that fits into the payload field of an ATM cell.

Selector (SEL) - A subfield carried in SETUP message part of ATM endpoint address Domain specific Part (DSP) defined by ISO 10589, not used for ATM network routing, used by ATM end systems only.

Semipermanent Connection - a connection established via a service order or via network management.

Serial Line IP (SLIP) - A protocol used to run IP over serial lines, such as telephone circuits or RS-232 cables, interconnecting two systems.

Service Access Point (SAP) - the point at which an entity of a layer provides services to its LM entity or to an entity of the next higher layer.

Service Data Unit (SDU) - a unit of interface information whose identity is preserved from one end of a layer connection to the other.

Service Specific Connection Oriented Protocol (SSCOP) - an adaptation layer protocol defined in ITU-T Specification: Q.2110.

Service Specific Convergence Sublayer (SSCS) - The portion of the convergence sublayer that is dependent upon the type of traffic that is being converted.

Session Layer - Layer 5 in the OSI model that is responsible for establishing and managing sessions between the application programs running in different nodes.

Severely Errored Seconds (SES) - a second during which more event errors have occurred than the SES threshold (normally 10-3).

Shaping Descriptor - *n* ordered pairs of GCRA parameters (I,L) used to define the negotiated traffic shape of an APP connection. The traffic shape refers to the load-balancing of a network, where load-balancing means configuring data flows to maximize network efficiency.

Shielded Pair - Two insulated wires in a cable wrapped with metallic braid or foil to prevent interference and provide noise free transmission.

Shielded Twisted Pair (STP) - two or more insulated wires, twisted together and then wrapped in a cable with metallic braid or foil to prevent interference and offer noise-free transmissions.

Signaling System No. 7 (SS7) - The SS7 protocol has been specified by ITU-T and is a protocol for interexchange signaling.

Simple and Efficient Adaptation Layer (SEAL) - also called AAL 5, this ATM adaptation layer assumes that higher layer processes will provide error recovery, thereby simplifying the SAR portion of the adaptation layer. Using this AAL type packs all 48 bytes of an ATM cell information field with data. It also assumes that only one message is crossing the UNI at a time. That is, multiple end-users at one location cannot interleave messages on the same VC, but must queue them for sequential transmission.

Simple Gateway Management Protocol (SGMP) - the predecessor to SNMP.

Simple Mail Transfer Protocol (SMTP) - the Internet electronic mail protocol used to transfer electronic mail between hosts.

Simple Network Management Protocol (SNMP) - the Internet standard protocol for managing nodes on an IP network.

Simple Protocol for ATM Network Signalling (SPANS) - FORE Systems' proprietary signalling protocol used for establishing SVCs between FORE Systems equipment.

Single Mode Fiber (SMF) - Fiber optic cable in which the signal or light propagates in a single mode or path. Since all light follows the same path or travels the same distance, a transmitted pulse is not dispersed and does not interfere with adjacent pulses. SMF fibers can support longer distances and are limited mainly by the amount of attenuation. Refer to MMF.

Small Computer Systems Interface (SCSI) - a standard for a controller bus that connects hardware devices to their controllers on a computer bus, typically used in small systems.

Smart PVC (SPVC) - a generic term for any communications medium which is permanently provisioned at the end points, but switched in the middle. In ATM, there are two kinds of SPVCs: smart permanent virtual path connections (SPVPCs) and smart permanent virtual channel connections (SPVCCs).

snmpd - an SMNP agent for a given adapter card.

Source - Part of communications system which transmits information.

Source Address (SA) - The address from which the message or data originated.

Source MAC Address (SA) - A six octet value uniquely identifying an end point and which is sent in an IEEE LAN frame header to indicate source of frame.

Source Traffic Descriptor - a set of traffic parameters belonging to the ATM Traffic Descriptor used during the connection set-up to capture the intrinsic traffic characteristics of the connection requested by the source.

Spanning Tree Protocol - provides loop-free topology in a network environment where there are redundant paths.

Static Route - a route that is entered manually into the routing table.

Statistical Multiplexing - a technique for allowing multiple channels and paths to share the same link, typified by the ability to give the bandwidth of a temporarily idle channel to another channel.

Stick and Click (SC) - Designation for an Optical Connector featuring a 2.5 mm physically contacting ferrule with a push-pull mating design. Commonly referred to as Structured Cabling, Structured Connectors or Stick and Click

Stick and Turn (ST) - A fiber-optic connector designed by AT&T which uses the bayonet style coupling rather than screw-on as the SMA uses. The ST is generally considered the eventual replacement for the SMA type connector.

Store-and-Forward - the technique of receiving a message, storing it until the proper outgoing line is available, then retransmitting it, with no direct connection between incoming and outgoing lines.

Straight Tip (ST) - see *Stick and Turn*.

Structured Cabling (SC) - see *Stick and Click.*

Structured Connectors (SC) - see *Stick and Click*.

Sublayer - a logical subdivision of a layer.

SubNetwork Access Protocol (SNAP) - a specially reserved variant of IEEE 802.2 encoding SNAP indicates to look further into the packet where it will fine a Type field.

Subscriber Network Interface (SNI) - the interface between an SMDS end user's CPE and the network directly serving the end user, supported by either a DS1 or DS3 access arrangement.

Super Frame (SF) - a term used to describe the repeating 12 D4 frame format that composes a standard (non-ESF) T1 service.

Super User - a login ID that allows unlimited access to the full range of a device's functionality, including especially the ability to reconfigure the device and set passwords.

Sustainable Cell Rate (SCR) - ATM Forum parameter defined for traffic management. For VBR connections, SCR determines the long-term average cell rate that can be transmitted.

Sustained Information Rate (SIR) - In ATM this refers to the long-term average data transmission rate across the User-to-Network Interface. In SMDS this refers to the committed information rate (similar to CIR for Frame Relay Service).

Switch - Equipment used to interconnect lines and trunks.

Switched Connection - A connection established via signaling.

Switched Multimegabit Data Service (SMDS) - a high-speed, datagram-based, public data network service expected to be widely used by telephone companies in their data networks.

Switched Virtual Channel Connection (SVCC) - A Switched VCC is one which is established and taken down dynamically through control signaling. A Virtual Channel Connection (VCC) is an ATM connection where switching is performed on the VPI/VCI fields of each cell.

Switched Virtual Circuit (or Channel) (SVC) - a channel established on demand by network signalling, used for information transport between two locations and lasting only for the duration of the transfer; the datacom equivalent of a dialed telephone call.

Switched Virtual Path Connection (SVPC) - a connection which is established and taken down dynamically through control signaling. A Virtual Path Connection (VPC) is an ATM connection where switching is performed on the VPI field only of each cell.

Switching System - A set of one or more systems that act together and appear as a single switch for the purposes of PNNI routing.

Symmetric Connection - a connection with the same bandwidth specified for both directions.

Synchronous - signals that are sourced from the same timing reference and hence are identical in frequency.

Synchronous Data Link Control (SDLC) - IBM's data link protocol used in SNA networks.

Synchronous Optical Network (SONET) - a body of standards that defines all aspects of transporting and managing digital traffic over optical facilities in the public network.

Synchronous Payload Envelope (SPE) - the payload field plus a little overhead of a basic SONET signal.

Synchronous Transfer Mode (STM) - a transport and switching method that depends on information occurring in regular, fixed patterns with respect to a reference such as a frame pattern.

Synchronous Transport Signal (STS) - a SONET electrical signal rate.

Systeme En Coleur Avec Memoire (SECAM) - Sequential and Memory Color Television - Started in France in the late 60s, and used by other countries with a political affiliation. This is. The B-Y and R-Y signals are transmitted on alternate lines modulated on an FM subcarrier. The memory is a one line delay line in the receiver to make both color difference signals available at the same time on all lines. Due to FM, the signal is robust in difficult terrain.

Systems Network Architecture (SNA) - a proprietary networking architecture used by IBM and IBM-compatible mainframe computers.

T1 - a specification for a transmission line. The specification details the input and output characteristics and the bandwidth. T1 lines run at 1.544 Mbps and provide for 24 data channels. In common usage, the term “T1” is used interchangeably with “DS1.”

T1 Link - A wideband digital carrier facility used for transmission of digitized voice, digital data, and digitized image traffic. This link is composed of two twisted-wire pairs that can carry 24 digital channels, each operating at 64K bps at the aggregate rate of 1.544M bps, full duplex. Also referred to as DS-1.

T3 - a specification for a transmission line, the equivalent of 28 T1 lines. T3 lines run at 44.736 Mbps. In common usage, the term “T3” is used interchangeably with “DS3.”

Tachometer - in *ForeView*, the tachometer shows the level of activity on a given port. The number in the tachometer shows the value of a chosen parameter in percentage, with a colored bar providing a semi-logarithmic representation of that percentage.

Tagged Cell Rate (TCR) - An ABR service parameter, TCR limits the rate at which a source may send out-of-rate forward RM-cells. TCR is a constant fixed at 10 cells/second.

Telephony - The conversion of voices and other sounds into electrical signals which are then transmitted by telecommunications media.

Telnet - a TCP/IP protocol that defines a client/server mechanism for emulating directly-connected terminal connections.

Terminal Equipment (TE) - Terminal equipment represents the endpoint of ATM connection(s) and termination of the various protocols within the connection(s).

Throughput - Measurement of the total useful information processed or communicated by a computer during a specified time period, i.e. packets per second.

Time Division Multiplexing (TDM) - a method of traditional digital multiplexing in which a signal occupies a fixed, repetitive time slot within a higher-rate signal.

Token Ring - a network access method in which the stations circulate a token. Stations with data to send must have the token to transmit their data.

topology - a program that displays the topology of a FORE Systems ATM network. An updated topology can be periodically re-displayed by use of the interval command option.

Traffic - the calls being sent and received over a communications network. Also, the packets that are sent on a data network.

Traffic Management (TM) - The traffic control and congestion control procedures for ATM. ATM layer traffic control refers to the set of actions taken by the network to avoid congestion conditions. ATM layer congestion control refers to the set of actions taken by the network to minimize the intensity, spread and duration of congestion. The following functions form a framework for managing and controlling traffic and congestion in ATM networks and may be used in appropriate combinations:

Connection Admission Control
Feedback Control
Usage Parameter Control
Priority Control
Traffic Shaping
Network Resource Management
Frame Discard
ABR Flow Control

Traffic Parameter - A parameter for specifying a particular traffic aspect of a connection.

Trailer - the protocol control information located at the end of a PDU.

Transit Delay - the time difference between the instant at which the first bit of a PDU crosses one designated boundary, and the instant at which the last bit of the same PDU crosses a second designated boundary.

Transmission Control Protocol (TCP) - a specification for software that bundles and unbundles sent and received data into packets, manages the transmission of packets on a network, and checks for errors.

Transmission Control Protocol/Internet Protocol (TCP/IP) - a set of communications protocols that has evolved since the late 1970s, when it was first developed by the Department of Defense. Because programs supporting these protocols are available on so many different computer systems, they have become an excellent way to connect different types of computers over networks.

Transmission Convergence (TC) - generates and receives transmission frames and is responsible for all overhead associated with the transmission frame. The TC sublayer packages cells into the transmission frame.

Transmission Convergence Sublayer (TCS) - This is part of the ATM physical layer that defines how cells will be transmitted by the actual physical layer.

Transparent Asynchronous Transmitter/Receiver Interface (TAXI) - Encoding scheme used for FDDI LANs as well as for ATM; supports speed typical of 100 Mbps over multimode fiber.

Transport Layer - Layer Four of the OSI reference model that is responsible for maintaining reliable end-to-end communications across the network.

trap - a program interrupt mechanism that automatically updates the state of the network to remote network management hosts. The SNMP agent on the switch supports these SNMP traps.

Trivial File Transfer Protocol (TFTP) - Part of IP, a simplified version of FTP that allows files to be transferred from one computer to another over a network.

Twisted Pair - Insulated wire in which pairs are twisted together. Commonly used for telephone connections, and LANs because it is inexpensive.

Unassigned Cells - a generated cell identified by a standardized virtual path identifier (VPI) and virtual channel identifier (VCI) value, which does not carry information from an application using the ATM Layer service.

Unavailable Seconds (UAS) - a measurement of signal quality. Unavailable seconds start accruing when ten consecutive severely errored seconds occur.

UNI 3.0/3.1 - the User-to-Network Interface standard set forth by the ATM Forum that defines how private customer premise equipment interacts with private ATM switches.

Unicasting - The transmit operation of a single PDU by a source interface where the PDU reaches a single destination.

Universal Test & Operations Interface for ATM (UTOPIA) - Refers to an electrical interface between the TC and PMD sublayers of the PHY layer.

Unshielded Twisted Pair (UTP) - a cable that consists of two or more insulated conductors in which each pair of conductors are twisted around each other. There is no external protection and noise resistance comes solely from the twists.

Unspecified Bit Rate (UBR) - a type of traffic that is not considered time-critical (e.g., ARP messages, pure data), allocated whatever bandwidth is available at any given time. UBR traffic is given a “best effort” priority in an ATM network with no guarantee of successful transmission.

Uplink - Represents the connectivity from a border node to an upnode.

Usage Parameter Control (UPC) - mechanism that ensures that traffic on a given connection does not exceed the contracted bandwidth of the connection, responsible for policing or enforcement. UPC is sometimes confused with congestion management (see *congestion management*).

User Datagram Protocol (UDP) - the TCP/IP transaction protocol used for applications such as remote network management and name-service access; this lets users assign a name, such as “RVAX*2,S,” to a physical or numbered address.

User-to-Network Interface (UNI) - the physical and electrical demarcation point between the user and the public network service provider.

V.35 - ITU-T standard describing a synchronous, physical layer protocol used for communications between a network access device and a packet network. V.35 is most commonly used in the United States and Europe, and is recommended for speeds up to 48 Kbps.

Variable Bit Rate (VBR) - a type of traffic that, when sent over a network, is tolerant of delays and changes in the amount of bandwidth it is allocated (e.g., data applications).

Virtual Channel (or Circuit) (VC) - a communications path between two nodes identified by label rather than fixed physical path.

Virtual Channel Connection (VCC) - a unidirectional concatenation of VCLs that extends between the points where the ATM service users access the ATM Layer. The points at which the ATM cell payload is passed to, or received from, the users of the ATM Layer (i.e., a higher layer or ATMM-entity) for processing signify the endpoints of a VCC.

Virtual Channel Identifier (VCI) - the address or label of a VC; a value stored in a field in the ATM cell header that identifies an individual virtual channel to which the cell belongs. VCI values may be different for each data link hop of an ATM virtual connection.

Virtual Channel Link (VCL) - a means of unidirectional transport of ATM cells between the point where a VCI value is assigned and the point where that value is translated or removed.

Virtual Channel Switch - a network element that connects VCLs. It terminates VPCs and translates VCI values. The Virtual Channel Switch is directed by Control Plane functions and relays the cells of a VC.

Virtual Connection - an endpoint-to-endpoint connection in an ATM network. A virtual connection can be either a virtual path or a virtual channel.

Virtual Local Area Network (VLAN) - Work stations connected to an intelligent device which provides the capabilities to define LAN membership.

Virtual Network Software (VINES) - Banyan’s network operating system based on UNIX and its protocols.

Virtual Path (VP) - a unidirectional logical association or bundle of VCs.

Virtual Path Connection (VPC) - a concatenation of VPLs between virtual path terminators (VPTs). VPCs are unidirectional.

Virtual Path Identifier (VPI) - the address or label of a particular VP; a value stored in a field in the ATM cell header that identifies an individual virtual path to which the cell belongs. A virtual path may comprise multiple virtual channels.

Virtual Path Link (VPL) - a means of unidirectional transport of ATM cells between the point where a VPI value is assigned and the point where that value is translated or removed.

Virtual Path Switch - a network element that connects VPLs, it translates VPI (not VCI) values and is directed by Control Plane functions. The Virtual Path Switch relays the cells of a Virtual Path.

Virtual Path Terminator (VPT) - a system that unbundles the VCs of a VP for independent processing of each VC.

Virtual Private Data Network (VPDN) - a private data communications network built on public switching and transport facilities rather than dedicated leased facilities such as T1s.

Virtual Private Network (VPN) - a private voice communications network built on public switching and transport facilities rather than dedicated leased facilities such as T1s.

Virtual Source/Virtual Destination (VS/VD) - An ABR connection may be divided into two or more separately controlled ABR segments. Each ABR control segment, except the first, is sourced by a virtual source. A virtual source implements the behavior of an ABR source endpoint. Backwards RM-cells received by a virtual source are removed from the connection. Each ABR control segment, except the last, is terminated by a virtual destination. A virtual destination assumes the behavior of an ABR destination endpoint. Forward RM-cells received by a virtual destination are turned around and not forwarded to the next segment of the connection.

Virtual Tributary (VT) - a structure used to carry payloads such as DS1s that run at significantly lower rates than STS-1s.

Warm Start Trap - an SNMP trap which indicates that SNMP alarm messages or agents have been enabled.

Wide-Area Network (WAN) - a network that covers a large geographic area.

Wideband Channel - Communications channel with more capacity (19.2K bps) than the standard capacity of a voice grade line.

X.21 - ITU-T standard for serial communications over synchronous digital lines. The X.21 protocol is used primarily in Europe and Japan.

X.25 - a well-established data switching and transport method that relies on a significant amount of processing to ensure reliable transport over metallic media.

Yellow Alarm - An alarm signal sent back toward the source of a failed signal due to the presence of an AIS (may be used by APS equipment to initiate switching).

Zero Byte Time Slot Interchange (ZBTSI) - A technique used with the T carrier extended superframe format (ESF) in which an area in the ESF frame carries information about the location of all-zero bytes (eight consecutive “0”s) within the data stream.

Zero Code Suppression - The insertion of a “1” bit to prevent the transmission of eight or more consecutive “0” bits. Used primarily with T1 and related digital telephone company facilities, which require a minimum “1’s density” in order to keep the individual subchannels of a multiplexed, high speed facility active.

Zero-Bit Insertion - A technique used to achieve transparency in bit-oriented protocols. A zero is inserted into sequences of one bits that cause false flag direction.

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